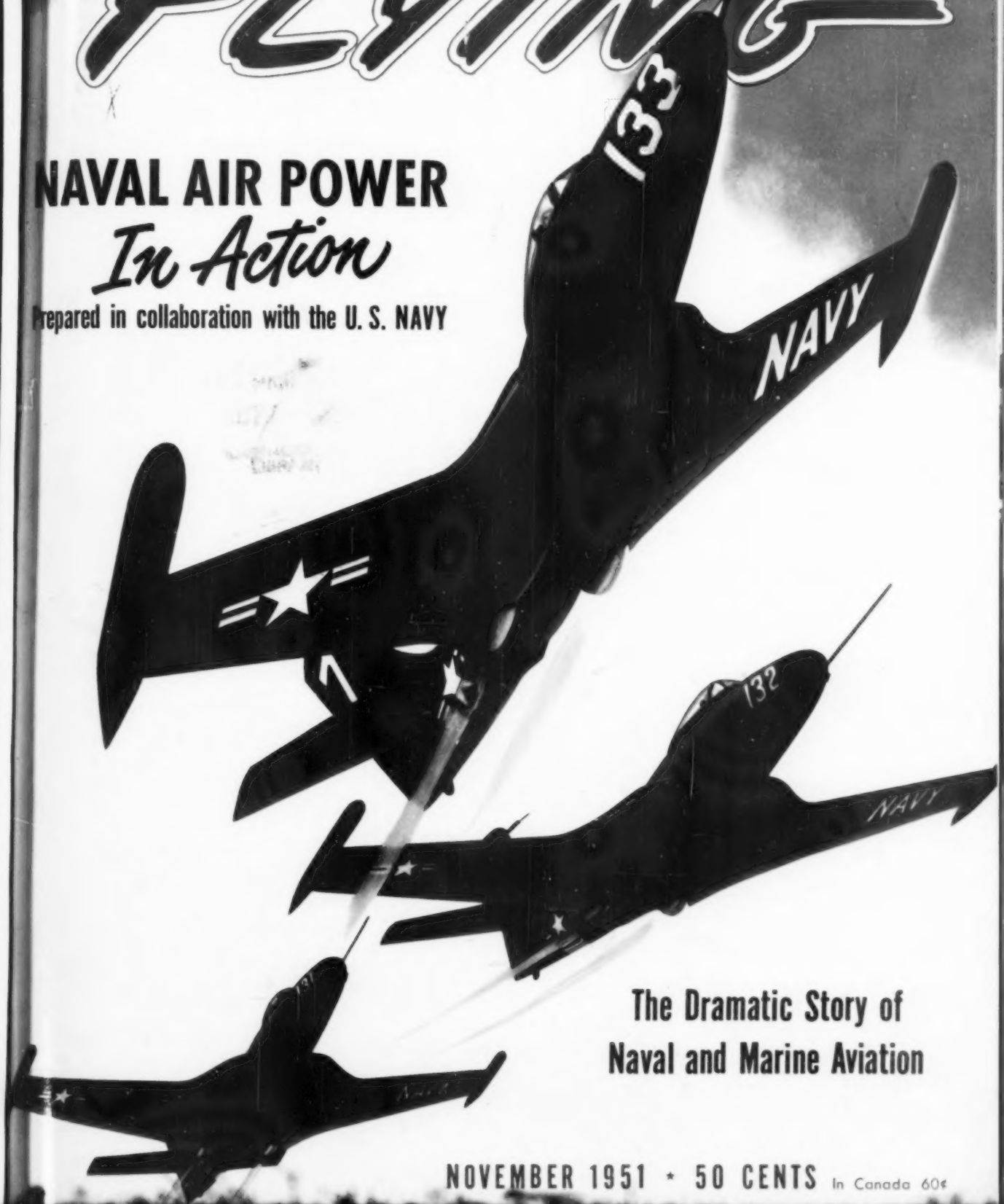
Special **NAVAL AVIATION** Issue

FLYING

NAVAL AIR POWER *In Action*

Prepared in collaboration with the U. S. NAVY



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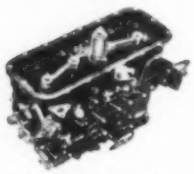

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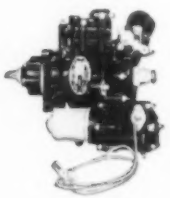

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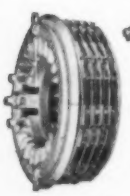

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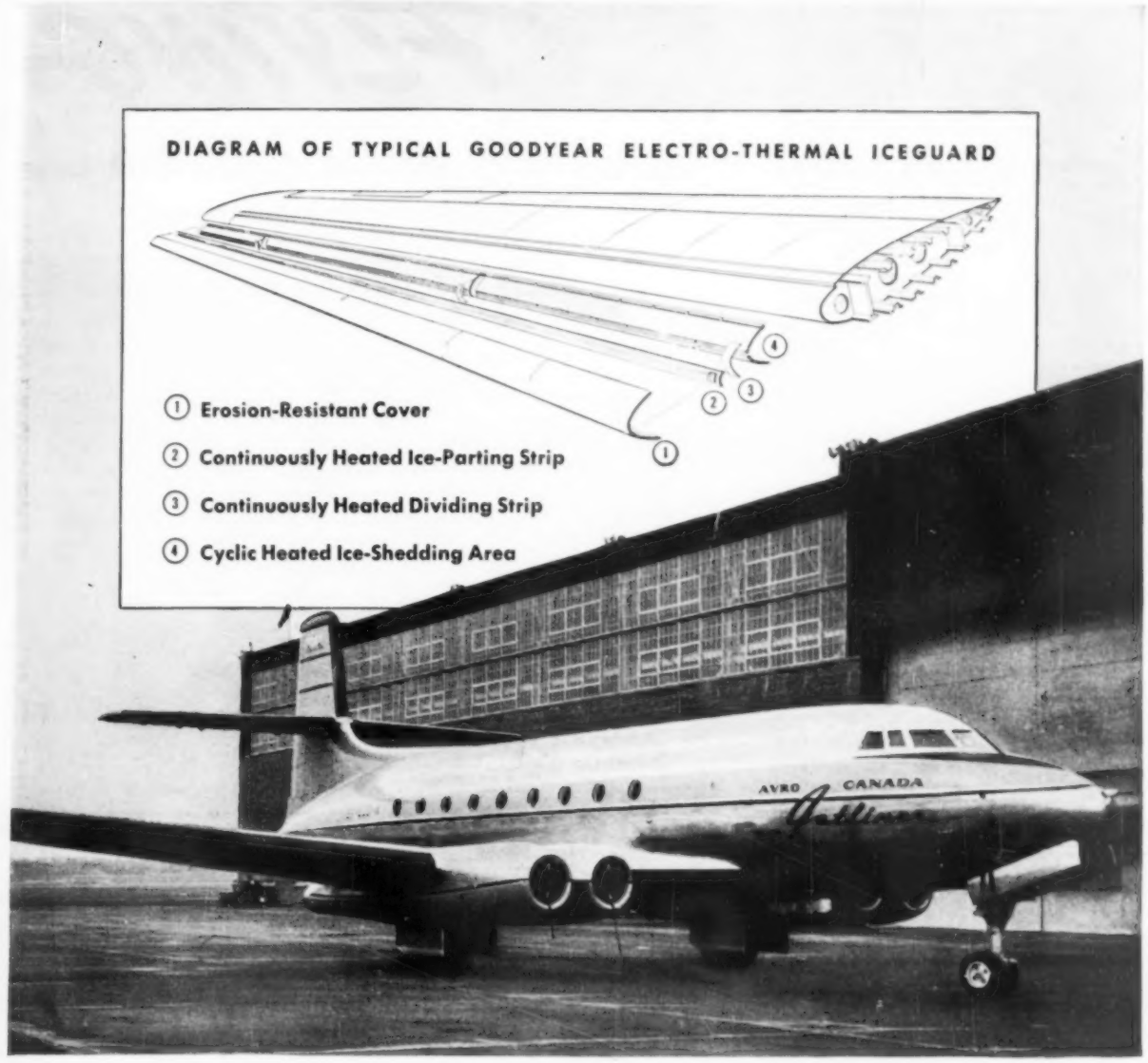

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Special Photography, Navy Issue
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Associate Advertising Director
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BRANCH OFFICES

CHICAGO (1)
185 N. Wabash
AN 3-5200

LOS ANGELES (14)
815 S. Hill St., TUcker 9213

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Special **U. S. NAVAL AVIATION** Issue

Prepared in collaboration with the United States Navy

NOVEMBER, 1951

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FLYING
VOLUME 49, NO. 5
NOVEMBER, 1951

Foreword

IN THIS REPORT to the nation, the United States Navy gives, within the limits imposed by security needs, a general round-up of the activities and operations which center around its air arm. This account is more than a mere outline of the machinery and tables of operation. It provides a working understanding of the techniques by which modern sea-power is held and its relation to the general blueprint of action of the total American security establishment.

Within this complex pattern of machines and methods so different from the navies of an earlier day, the reader will feel the pulsing spirit of the great traditions which have characterized the American Navy since its beginnings.

In this hour of world-wide menace, where the entire future of our country hangs in the balance, the power structure of the Navy and of its rapidly enlarging air arm take on new and even more important meanings. It is no mere coincidence, therefore, than an entire issue of FLYING is being devoted at this time to the question of naval aviation and its readiness to play its own chosen role in the general scheme of National security.

This year marks the 40th anniversary of the naval air arm. Great events have taken place and radical changes have been made in the tables of operation since Lieutenants Ellyson, Rodgers and Towers first carried the Navy's colors aloft in 1911. Two major wars have been fought. On the technical side, we have broken through the sonic barrier and penetrated far into the stratosphere. We have seen the debut of the electronic and atomic age with its incalculable possibilities.

The amazing developments of modern technology have themselves been paced by naval and military research.

In all of these advancements, naval air has taken a conspicuous part. In much of the research, its pilots, engineers and chemists have pioneered.

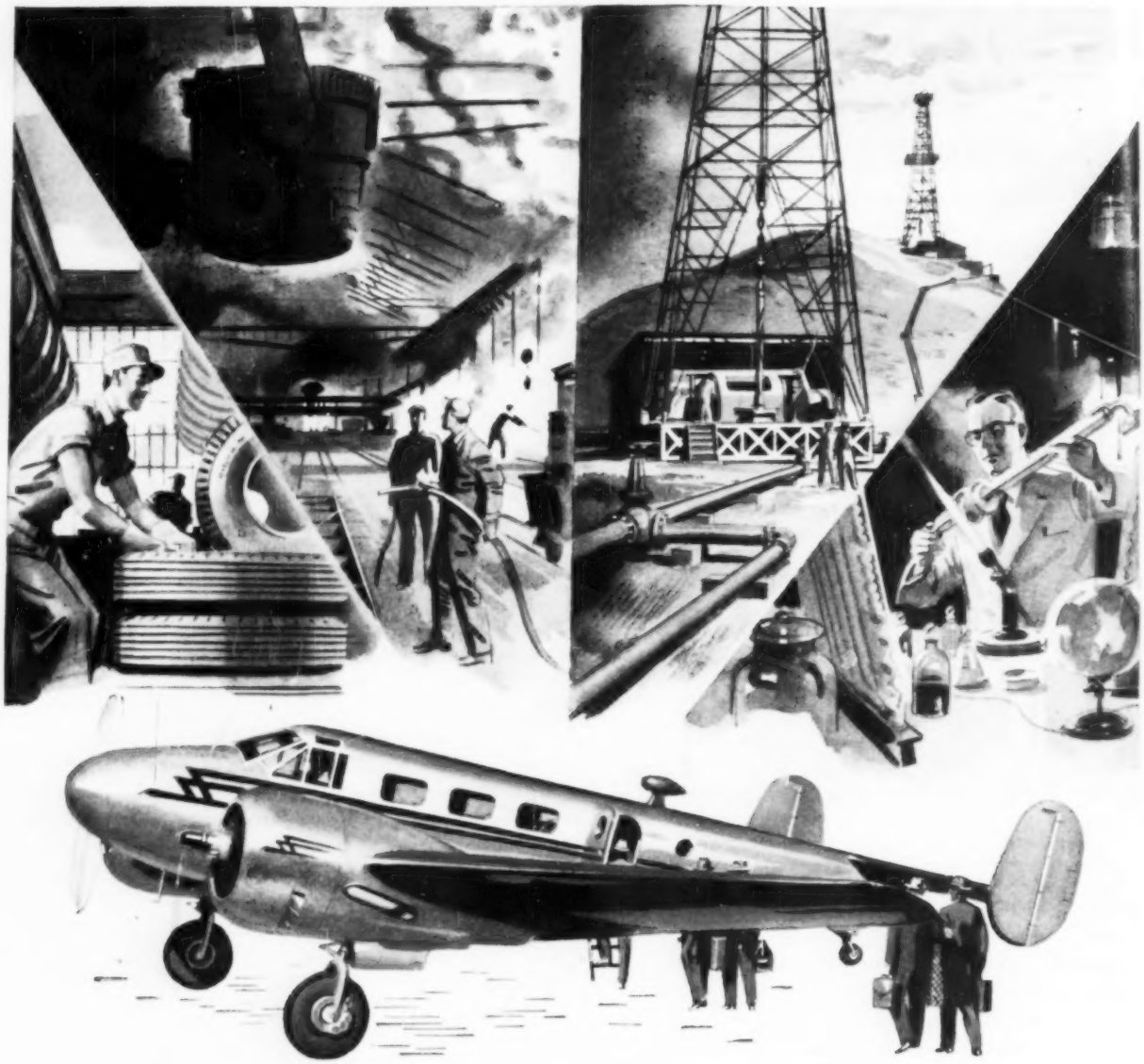
The old sea dogs of a generation ago would not recognize this Navy, which would seem to them something out of pure fantasy. Indeed the pilots who flew strikes in the Yellow Sea and the Sea of Japan against Korean targets, have little to remind them of the machines and operations which characterized World War II. The advent of turbojets, of new and vastly more powerful carrier-based bombers, of new rockets and guns, has literally transmuted our air navy into a new phase of its existence. As with its sister military establishments, the air navy has been streamlined to meet the impelling demands of modern technological warfare.

The pages which follow have been prepared with the assistance of the officers and the various commands of the United States Navy. For their part in its preparation acknowledgement should be made to the Honorable Dan A. Kimball, Secretary of the Navy, to Admiral William Fechteler and to those officers and personnel who made this joint venture possible.

In particular our thanks must go to Admiral Forrest P. Sherman whose untimely death has been so tragic a loss to this nation, for it was under his inspiration and direction that the first outlines of this report were prepared. The assurance and pride which the American people must take from these pages will constitute a living tribute to the genius of a great American leader who expressed in his lifetime the best and noblest in the long and glorious tradition of the American fighting services.

William B. Ziff

William B. Ziff
Publisher of FLYING



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BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS

Introduction

By DAN A. KIMBALL

Secretary of the Navy

Secretary Kimball went through the Army Air Corps flight training course in World War I, commanded several flying fields and at war's end entered private business. In later years, as head of Aerojet Engineering Corporation, he took a leading part in development of rockets and other advanced methods of propulsion. He became Assistant Secretary of the Navy for Air Feb. 11, 1949; Undersecretary of the Navy May 19, 1949, and Secretary of the Navy July 31, 1951.

History has a way of moving faster than the record. We are, for example, just beginning to see World War II in proper perspective, as the experts review and reappraise the events of those headlong years.

Useful sources for such a purpose have been the two massive issues of FLYING Magazine, one in February of 1943 and the second in October of 1944, issues which were devoted to wartime Naval Aviation.

By the same token, I believe that this present issue of FLYING, bringing readers up-to-date on the swift-moving developments and far-flung responsibilities shared by Naval and Marine Corps Aviation, will prove a future reference work for layman and expert alike.

The splendid performance of our forces in Korea is here recorded. The vital part that Research and Development plays is brought home in a series of thoughtful articles. The past, back to that first lonely flight of Eugene Ely 40 years ago, is not neglected. I am glad to see that the stalwart role played by the "citizen airmen" of the Naval Reserve has been given the prominence it deserves.

A clear picture of Naval Aviation in Action emerges. But it would, I feel, be a mistake to take the part for the whole.

As Secretary of the Navy I would like to remind you, the reader, that no part of your Navy today can be complete in itself. The fast carrier striking force consists of picket destroyers and protecting cruisers as well as the ships and planes which actually deliver the punch.

The hovering helicopter spots the mines lurking below the surface, but the little wooden minesweeper goes in and sweeps the mine. Submarine and surface ship, shore station and plane, overseas base and secret research center—all are interdependent.

The goal for all who serve remains the same: Security in an uncertain world. By security I mean preservation of the American Liberties, and swift retaliation of aggression anywhere, and at any time, by any one.

It seems to me that the part Naval Aviation is playing in helping to achieve such security has been admirably presented in the pages that follow.

SERVING the CAUSE of PEACE

By JOHN F. FLOBERG
Assistant Secretary of the Navy for Air

THE NAVAL SERVICE, of which naval aviation is an integral part, stands alongside her sister services in deterring aggression by letting any would-be aggressor see in advance that his assaults would fail in the face of America's over-all might, and by standing ready to deliver in retribution for any assault upon our country the most powerful weapons that science has been able to create.

It is just a few months more than 40 years ago that Eugene Ely first flew his Curtiss "aeroplane" off the platform on the bow of the BIRMINGHAM, since he first landed on and took off from a similar platform on the stern of the PENNSYLVANIA, and since the Navy contracted for the purchase of its first "flying machines." It is just a few months less than 30 years ago since the LANGLEY began her career as the laboratory for the early development of carrier aviation.

In the 40-year history of United States naval aviation the last decade has brought far more progress than did the three previous decades combined. That statement is, of course, true of aviation in general, but I believe that it is even more dramatically true of naval aviation than it is of any other aeronautical field. Yet it is safe to say that the next decade will see the Navy and Marine Corps achieve more accomplishments in aviation than everything that has passed to date, for naval aviation stands at the threshold of an era of unprecedented development. Spectacular as will be the development in land-based planes, the tremendous demands which modern and future aircraft are going to make on take-off, landing, and servicing facilities will offer increasingly great advantages to water-based and carrier-based planes.

Just as the Navy is a vital and integral part of the defense team and of the over-all military strength of the nation so naval aviation is an integral part of the Naval service and performs an indispensable function both in the Navy's historic primary role of maintaining control of that 70 per cent of the earth's surface which is salt water and in the Navy's secondary missions.

Our nation has enjoyed this control for so long that Americans are inclined to take it for granted, but it is important to remember that that control, indispensable to national security and prosperity, has always been secured and maintained by mounting the weapon of the day, be it sword, catapult, gun, or airplane, on a ship. This control must accomplish two objectives—guarantee the free use of the sea and air lanes by our own ships and aircraft and deny the use of them by any possible enemy. The latter function is one that is frequently overlooked, but its importance can be judged by contemplating that, had we no aircraft carriers and if an enemy had our carrier and other Naval aeronautical force, we would need many times the land-based aircraft to protect our homeland and our commerce that we now require, if indeed it would be possible at all.

The frequently-assumed hypothesis that the Navy exists only to fight other navies, or that its effectiveness necessarily ends at an enemy's littoral, fails to recognize fully the significance of Naval power. Sometimes the fact that the airplane is just another weapon, although a most modern, versatile and powerful one, is overlooked. The differences, though significant, are only of degree between the gun which shoots a projectile and the attack plane which carries a bomb. Occasionally one hears the air referred to as a "new medium" for the waging of war, but actually it is as old as is hostile action itself. The air is the medium through which the stone flew from the first slingshot, through which the arrow flew from the first bow, but the contribution of modern ingenuity has been to devise the method of insuring that sling and slinger, bow and bowman, accompany the projectile over great ranges to the target to insure a devastating hit.

Not many people realize the extensive part played by aviation in the Navy and Marine Corps and by naval aviation in the national defense scheme. I doubt, for example, that many Americans outside the Military Establishment itself realize that about a third of the nation's air power, measured in number of operating planes and pilots, is embodied in the Navy and Marine Corps; United States naval aviation is, in fact, second only to the great United States Air Force as the largest unit of air power outside the Iron Curtain. I doubt, furthermore, that many Americans realize that more than a quarter of all the line officers in the Navy and more than a quarter of all the officers in the Marine Corps are rated pilots in a flight status. I doubt that many Americans realize that well above one-third of all the U.S. combat missions flown in the past year and more than one-fourth of all the U.S. missions flown in the Korean war have been by Naval and Marine aviators.

The Navy well realizes that no one of the services is truly independent of the others, that no one can be so fully self-contained as to operate without regard to the others and that no one will ever be able to force the decision in a war without considering the others.

Just as no war in the near future could be won by air power alone but could be lost without it, so also the Navy's missions could neither be accomplished by naval air power alone nor without it. The Navy serves the cause of peace and security of our beloved country and of the free world and aviation, the Naval service's most devastating striking force, stands ready to do its part in the service of that cause.

END

The original concept and preliminary planning for this special issue had received the personal approval and warm backing of the late Admiral Forrest Sherman whose contributions in the field of naval air power and in the wider realms of world strategy have gone into history. His successor as Chief of Naval Operations and Navy member of the Joint Chiefs of Staff, Admiral William M. Fechteler, has stated in speeches and press interviews his intention to continue the policies of his great predecessor. It is a privilege to have his statement of support in the specific instance of this all-Navy edition.

—THE EDITORS.

Welcome Aboard

By ADMIRAL WILLIAM M. FECHTELER

Chief of Naval Operations

THE articles and photographs which form this issue of Flying Magazine bring forcibly home the central fact of Naval power today: that the carrier and her planes are the offensive spearhead of the Navy. They also form a well-rounded presentation of the many and grave responsibilities of Naval Aviation in a world where strength alone can spell security.

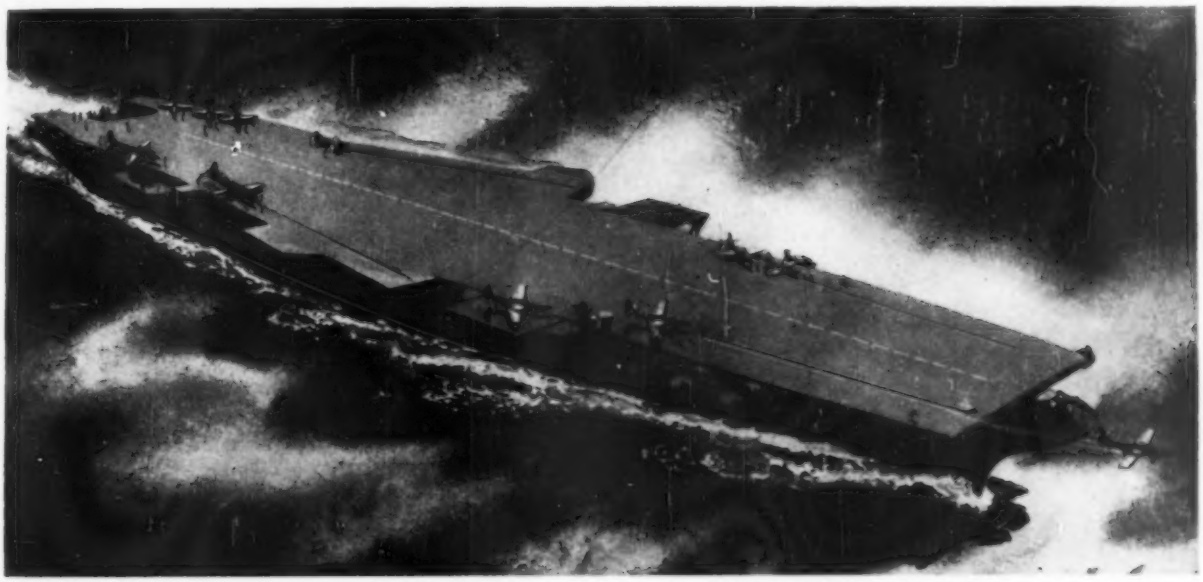
Such information is of great value in keeping the public fully informed up to the limits that security imposes.

It is therefore a privilege and a pleasure to give my hearty endorsement to this special issue.

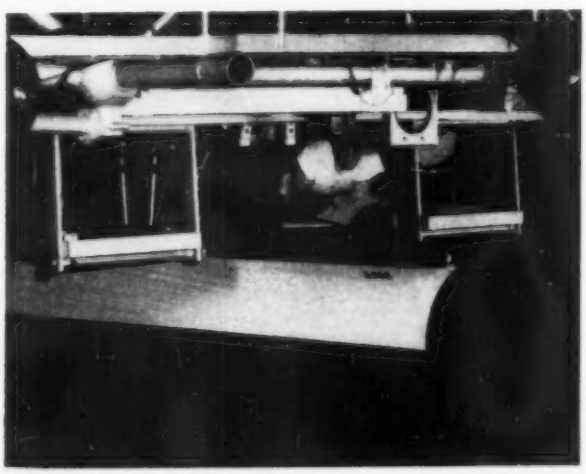
PREVIEW of the PROTOTYPE

The USS FORRESTAL, forerunner of a new class of flush-deck aircraft carriers, will carry larger, heavier aircraft.

Bow of USS FORRESTAL, showing knife-like edge characteristic of high-speed vessels.



This drawing of a flush-deck carrier may be a fair approximation of what the USS FORRESTAL will look like when completed.



Technicians at Taylor Model Basin about to start self-propelled carriage to test the effective horsepower of the carrier model.

LONG BEFORE the world's largest aircraft carrier, the flush-deck USS FORRESTAL, slides down the ways at Newport News, Va., in 1954 or 1955, the Navy will know most of its sea-going characteristics. The future performance of the 60,000-ton, 1,029-foot ship is now being blueprinted by experts as they put a 32-foot scale model, shown here in the first photographs released by the Navy, through a series of tests at the David Taylor Model Basin near Washington, D. C. The model is towed at various speeds under a self-propelled carriage, which carries a dynamometer to record effective horsepower. The hull is weighted to simulate exact displacement of guns, machinery, and superstructure. Other equally painstaking tests record all possible sea-going performance characteristics of the mighty ship-to-be. The USS FORRESTAL, which will cost $218,000,000, will have an extreme width of 252 feet. The great length of the vessel will permit larger, heavier aircraft to operate from her deck. The new carrier will have a retractable bridge. The island will be raised during navigation to increase radar search coverage, and lowered for flight operations. END

NAVAL POWER REAFFIRMED

By Adm. ARTHUR W. RADFORD, USN

Commander in Chief, U.S. Pacific Fleet

MANY VALUABLE LESSONS have been derived from the fighting in Korea, which if properly applied can spell greatly increased security for our country in the future. Foremost is the reawakening to the importance of our Naval power, spearheaded by Naval air power, without which there could be no United Nations forces in Korea today.

The start of Korea found the U. S. Navy and Marine Corps in a greatly weakened condition. The effects of the austerity period were lessened through rapid reactivation of moth balled ships and aircraft, and recall to duty of air and surface personnel from a splendid reserve program. But this was a cure and not a preventive. Strong and ready Naval forces, including Marines, provide a potent deterrent to any aggressor.

Korea has been a land war. There has been little enemy sea or air opposition. Yet in this land campaign, the role of the Navy has been as important and as vital as it ever has been in its long history, for Korea is over 5,000 miles from America and, like all other lands of importance, its coastline is bordered by salt water.

Support of the ground fighting in Korea by the Navy makes a fascinating picture in the variety of its operations. Naval logistical forces, the "life line" for Army, Air Force, and Navy needs, transported over 1,000,000 military personnel, more than 15,000,000 tons of food, ammunition and supplies and over 29,000,000 barrels of fuels across the Pacific in the first year of war. Navy transport planes, as in the Berlin airlift, contributed the same high standards of performance to the flying of critically needed personnel and material. The record-breaking Pacific crossing of the carrier BOXER with sorely needed Air Force fighter planes, personnel and material early in the campaign is an example both of inter-service cooperation and the indispensability of the Naval logistic function.

Navy combatant ships, assisted by Naval air, have clamped an air tight blockade on Korea, prevented the invasion of Formosa and provided highly effective naval gunfire to assist the advance of U.N. ground forces.

Amphibious forces proved vital in Korea and reaffirmed the Navy's position in this important field. Marines landing in assault at Inchon broke the back of the North Korean army and released our own 8th Army from the confines of the Pusan perimeter. Hungnam permitted the safe redeployment of over 105,000 ground troops with equipment. Both of these historic amphibious operations were made possible by superior close air support from mobile carrier bases nearby.

In fact, the performance of carrier forces was the highlight of Naval combat operations. Through inherent qualities of mobility and flexibility, the Carrier Task Force is a weapons system of great versatility capable of applying tremendous military power at point of our choosing from anywhere on the four-fifths of the earth's surface which is water. It is a priceless military asset not possessed by any potential enemy.

The multitude of lessons acquired from the testing ground of Korea can be invaluable when applied to conflicts of a similar nature, whose sporadic and continuing outbreak in the unsettled conditions of today's world is a most distinct probability. However, to treat Korea as a standard and pattern for all future war and build our defenses accordingly would be as great an error as to prepare solely for an all-out atomic blitz type of warfare. The Navy realizes the dangers of this extremist type of thinking. While adjusting itself to the peculiarities of present and future Koreas, it has and will continue to employ flexibility in its planning and keep its strategic horizons wide, to be prepared for a vaster emergency anywhere should it befall us.

Transonic Panther

A Marine Corps F9F, 600 m.p.h. turbo-jet fighter, takes elevator to flight deck of U.S.S. Franklin D. Roosevelt far at sea.

Grumman Panthers in Marine war paint. Several Russian MIG-15s have fallen before these fast fighters.

▲ Twin-jet, carrier-based Skynight has advanced radar.

Bat-wing Cutlass is a first-line Navy jet fighter. ▼

Designed especially for Essex-class carriers, the Douglas AD is one of the Navy's most versatile planes.

▲ AF-2S is killer unit of hunter-killer anti-sub team.

P5M Marlin also designed for anti-submarine warfare. ▼

Another version of the AD attack series. Bulging shell on this electronic Skyraider is plastic radome.

A2D Skyshark has propellers driven by two jet turbines.

Helicopter hovering near dye-stained rescue area.

First Navy patrol plane to have two piston and two jet engines is the long-range Mercator.

▲ Navy's AJ-1 bomber is one of largest carrier aircraft. Convair XP5Y-1 is long range, day-night search plane. ▼

An F7F Tigercat fighter (above) modified as a pilotless missile carrier. It is shown with two TD2G missiles attached to the wings. The KDM-1 Plover (below) is a pilotless, radio-controlled, ramjet-powered anti-aircraft gunnery target drone. Powerplant is a Marquardt 20-inch engine.

The Douglas D-558-2 Skyrocket research plane, which this year established a new supersonic speed record and reached a new altitude mark. It is shown with JATO. Below is a scale model of the Skyrocket under test by NACA at Wallops Island, Va. Note booster rocket behind the model.

PO-1W Constellation tests electronic systems for Naval planes. Note plane's radome and drones below.

Grumman F6F World War II fighters, converted to drones, on the ramp at the Pensacola overhaul depot.

Naval Air Power In Action

Korean landings and troop support have justified the Navy's faith in carriers and tactical combat teams.

WHEN THE INVASION of Korea heated the cold war half way to hot, there was nothing lukewarm about the reception the men aboard the carrier *Valley Forge* gave to the news that they would make a strike at the Korean capital.

Before the echoes of "Now hear this . . . now hear this . . . man your battle stations" had died away, the air was filled with a tremendous shout. Every man aboard the *Valley Forge* gave vent to his pent-up desire for action. Every man knew that his carrier was the only one in Far Eastern waters and upon him rested the chance to prove Naval Air Power in battle.

Only hours after the communists surged across the 38th parallel, General MacArthur sent an urgent request for additional carriers. On July 3rd, the *Valley Forge's* aircraft, including two new *Panther* squadrons smashed at the capital, Pyongyang, repeatedly. And to show MacArthur that he did not make a mistake in his faith in carriers, they celebrated Independence Day by giving the North Koreans a more devastating blasting the second day.

Before the month was out the silhouettes of 43 Chinese Red airplanes decorated the side of the carrier's bridge—all confirmed "kills."

Things happened fast in Korea after that. Occupation troops from Japan were committed—at first only enough to slow down the rampaging Red Army. Could American air strength help hold their thin lines and prevent them from being surrounded or thrown into the sea?

Already Air Force B-29's were pounding industrial targets of North Korea, but this could have little immediate result at the battle front. The Air Force F-80 "Shooting Stars" then on occupation duty in Japan had a primary role of protecting Japan from Red air assault.

The few flattops available on the west coast of the United States headed for Korea at flank speed—the *Boxer* crammed with 145 Air Force F-51 aircraft to be used for ground support work and 19 flivver planes for artillery spotting. Carriers *Philippine Sea*, *Sicily* and *Badoeng Strait* would go directly onto the battle line upon their arrival in early August.

During the precarious month of July, however, the

AD-4's taxiing to catapult, F9Fs in background, await "GO" signal for strike from USS PHILIPPINE SEA.

Valley Forge was going it alone for naval aviation. Strategic and tactical air power were tested in their battle roles in the effort to prevent a disaster in Korea and to rescue our troops. There was no argument about missions, as Air Force jets from Japan pitched in and did what they could. Even B-29's were pressed into emergency close air support service in a carpet-bombing experiment along the Naktong. One thousand tons of 500-pound bombs were dropped in a 27-mile-square concentration of Red troops.

Another example of how roles or missions were exchanged happened on 19 July at Wonsan, North Korea. With only 21 *Skyraiders* and *Corsairs*, the carrier airmen from the *Valley Forge* attacked the Wonsan oil refinery, one of the few strategic air targets in North Korea. This refinery received crude oil from the rich Russian fields of Sakhalin Island for refining, and had an estimated annual capacity of almost 1,700,000 barrels. From Wonsan, the refined products went to Russia and Red China.

The 10 Douglas *Skyraiders* were each carrying a 1000-pound bomb; the 11 *Corsairs*, a 500-pounder. All planes carried full rocket loads: 12 per *Skyraider*, eight per *Corsair*.

The attack was brief but devastating as the dive-bombers and fighters plunked their bombs into the refinery from low altitudes. Rockets were squirted into the storage tanks. Tremendous clouds of flame and smoke belched from the riddled refinery.

The naval aviators flew back to their carrier, 60 miles at sea, and from this distance the smoke was still visible, and the refinery burned for four days.

Meanwhile, 200 miles to the south, the ROK Army had all but disintegrated in the face of tank attacks supported by the well-trained, well-equipped Red Army. Our 24th Division, in a series of remarkable fire-fights, had succeeded in messing up the Red timetable, but it was still debatable whether or not the peninsula could be held. There was a surge of optimism on 18 July when the Navy succeeded in putting the First Cavalry Division ashore in an amphibious landing at Pohang.

In one day, a complete, fresh American division was ashore as a unit with its equipment to augment the 24th Division. Less than a week later, the First Cavalry met and defeated a major Red drive toward Taegu. Things were looking up.

But on 23 July, the situation worsened and overnight became desperate. The Red Army suddenly changed direction, and instead of running the ball again through center, now chose an end-run. The Reds swept through southwestern Korea and headed for Pusan.

Representatives of General MacArthur's staff in Tokyo sent for the Navy on the evening of July 23rd. The situation in Korea was exceedingly desperate, the Navy was informed; another Bataan was in the making; could the *Valley Forge* be ordered to hit the southwest corner and slow the Reds down? (Previously, it had been agreed to keep the carrier's planes generally north of Parallel 38). "Affirmative," said the Navy. It was very glad indeed to help despite the shortage of ground control parties, inadequate maps, and communication problems.

The *Valley Forge's* planes pitched in—AD *Skyraiders* labored off deck each carrying three 1000-pound bombs, 12 large rockets and full loads of 20-mm ammunition. The F4U *Corsairs* followed with 100-pound fragmentation bombs, eight rockets and a napalm tank. "What are you guys flying?" asked the Army ground parties in amazement, "Destroyers?"

The naval airmen were not satisfied with their subsequent efforts although the Air Force credited them as "magnificent." Many flights aborted because of a lack of ground control; others wasted their armament on "road surveillance" and target-of-opportunity hops rather than in the crucial battle area. However, it was enough, and by 2 August, although the Reds were now within 20 miles of Pusan, additional carriers—and the U. S. Marines—had arrived!

"Jury-rig" close air support by the Navy ended with the arrival of two jeep aircraft carriers and the Marine control parties in Korea. Now, at last, all elements were available. First of all, the "base" problem was solved. Airfields were few and primitive in Korea and all too few in Japan for the Air Force jets. The Navy solved this by steaming the close-air-support flattops within 15 minutes flying time of the front lines—often on the other side of weather fronts which impeded flights from Japan.

The flattop planes would report for close air support duty as soon as they were catapulted—and on arrival would stay on station three hours or more. Shuttles of planes from dawn to dusk would relieve each other on station leaving no daylight hours without air support.

AD-3 prepares to take off from carrier on a strike at Korea.

The planes would carry a variety of armament—1000-pound armor-piercing bombs for concrete and log-covered pits and road blocks; 500-pound bombs for tanks, bridges and artillery pieces; 100-pound bombs with VT fuses for anti-personnel use; Navy-developed RAM rockets capable of drilling through the armor plates of most modern tanks; plenty of ammunition for the planes' six machine guns; and best of all, napalm, that horrible fire bomb (which the Marines call "cooking oil"), destined to become the scourge of the North Korean People's Army and Chinese Communists.

In early August the situation ashore was still dangerous and no one was anxious yet to prophesy success. General Walker gave the newly-arrived First Provisional Marine Brigade a unique assignment comparable to the line-backer-upper of a football team. Whenever the Reds threatened to penetrate our still-thin lines, the Marines would be sent in to plug the hole before it opened—sort of a fire-brigade defense.

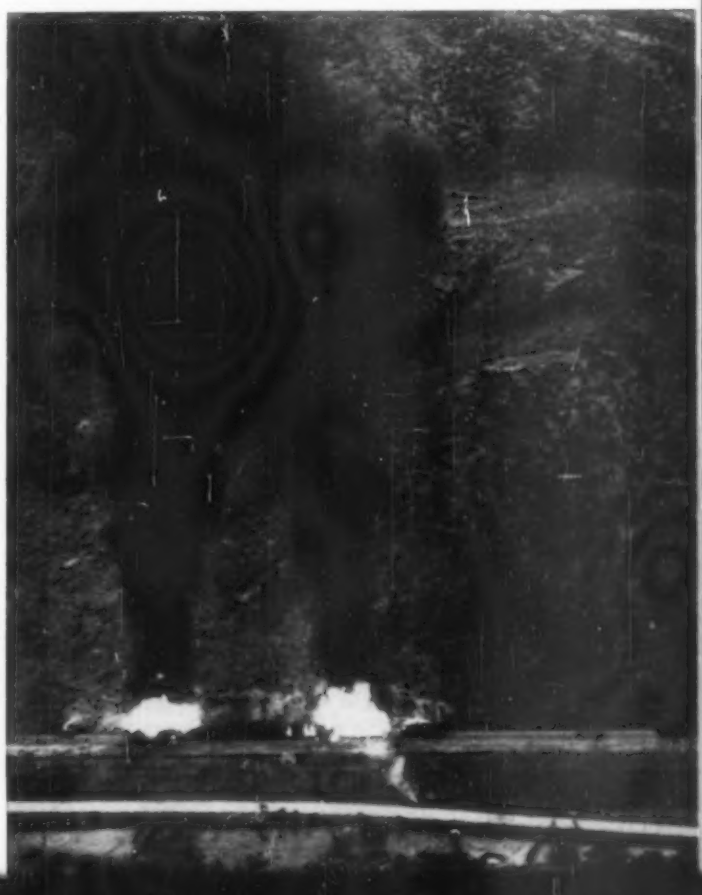
The Marines opened their offensive-defense on 6 August at Chinju on the southern front where the Reds were within artillery range of Pusan. Planes from the *Sicily* and *Badoeng Strait* led the way. The leatherneck airmen —each of whom had learned his soldiering with a pack on his back and a carbine in his hands hit the Reds with the old one-two, which had proved so effective at Iwo and Okinawa.

Since then, this highly-developed technique had continued to be an important part of every carrier squadron's curriculum. First came the planes to pulverize the enemy's road blocks, blast their artillery and mortars, overturn their tanks, strafe their machine gun nests, and lash their foxholes. Right behind them came the foot-slogging leathernecks.

The necessary coordination between ground and air—maps, phraseology, mutual understanding of the other's mission, and proper communications—were all available, and experience to boot. The pilots would take plenty of time to find and identify the chosen target. There would be no accidents or mistakes—hitting the wrong target, wasting a valuable bomb or rocket, or worst of all, killing some friendly troops.

As much as 30 minutes spent positively identifying the right target is considered well spent—it might only be a scant 50 yards from our own (*Continued on page* 174)

Marine F7F giving troops in foreground close air support. Below, enemy ammunition train is hit by Navy tactical bombings.



FLYING FIREPOWER

Firepower on the wing: An F4U firing rockets at target on Naval Ordnance Test Station range, Inyokern, Calif.

THE "FLYING FIREPOWER" of the United States Navy has a more powerful punch than it had when the Japanese were battered back for the knockout.

During the war in the Pacific we learned many things about the power wielded by naval aviation as a major weapon in sea battles. The old concept of naval tactics, centered around a tremendous slugging match between lines of battleships 10 or 15 miles apart with big guns belching, was changed radically.

The carrier and its planes vastly increased the speed of operations at sea and extended to heretofore-unheard-of distances the range and destructiveness of the fleet.

It was necessary during the war to adapt our strategic planning and our tactics rapidly to the new concepts. We developed to the highest practicable degree the use of the fast carrier task force in offensive sea warfare. We introduced the support carriers to accompany amphibious expeditions and to provide them with the air cover and support required during the initial landings and the first advances inland. We developed to a very high degree the use of small carriers in antisubmarine warfare, an idea initiated by the British. We carried the employment of patrol aircraft, both large sea planes and large land base planes, for search, for attack against surface craft, for photography and rescue and for use against submarines way beyond what we considered remotely possible a few years ago.

These battle-tried lessons, which we learned the hard way as we fought from Pearl Harbor to Tokyo Bay, from Britain to Normandy and from Africa to France, were a schooling of tremendous value to the Navy. In the years since the war we have remembered the lessons that were of permanent value and have built upon them. We have put our wartime education to good use.

When hostilities ceased, aviation was a major factor in the firepower of the Navy. Since the war, every effort has been made to insure that the weapons of naval aviation keep pace with the new designs of naval aircraft. The power, range, weight and general effectiveness of armament in fleet aviation in 1951 outclasses to a great degree what we had in 1945.

From the time the Japanese surrendered until the outbreak of the Korean affair in 1950 the principal effort of the Bureau of Ordnance was in research and development. The three chief fields of our scientific and engineering effort were under the heading of 1.) air defense, 2.) air combat operations and 3.) anti-submarine operations. Aircraft weapons were a major part in each.

Since Korea the emphasis has been changed from research and development to production. We are now bringing into service the fruits of those five years of hard research and development work. In this shift of emphasis the actual effort devoted to research and development is not being reduced.

At the present time approximately 60% of the dollar value of the production programs of the Bureau of Ordnance is going into aircraft weapons of some sort, airplane guns, ammunition, rockets, fire control, and airborne mines, bombs or torpedoes.

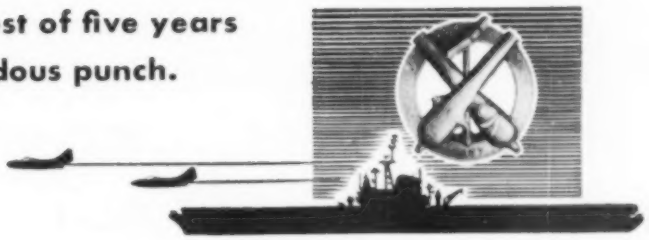
It is not generally realized that there is a considerable number of Naval Aviators regularly on duty in the Bureau of Ordnance, most of them, men who have taken special postgraduate courses in aviation ordnance. One of the first aviators to have duty in this Bureau was Admiral Forrest P. Sherman, the late Chief of Naval Operations. During his tour of duty in the Bureau during the early 1930's he was instrumental to the development and introduction into service of the Norden Bombsight and of the first torpedo designed in this country for purely aeronautical use. He also initiated the Navy's first program in aircraft fire control.

The Navy's program of research and development in aviation ordnance is closely coordinated with that of both the Air Force and of the Army Ordnance Department. Each of the services is kept fully aware of the scientific engineering work undertaken by the others. Each tries to utilize the weapons that result from this pooling.

The same policy is carried into the production field. As a result the Navy procures an important part of its aviation ordnance through the sister services and the Air Force places large orders for armament with the Navy.

Our gain in the firepower of aircraft guns has come largely from the general introduction of weapons of larger size than the .50 caliber with which the last war

Naval air firepower, reaping the harvest of five years of intensive research, carries a tremendous punch.



was so predominantly fought. It comes also from higher rates of fire and from improvements in the ballistics and hitting power of the projectiles. All of these, with improved fire control systems, mean long effective ranges.

The bombs of World War II were distinctly chunky in shape. They were well adapted to the conditions and to the air speeds of that time. When carried externally, as most of the Navy's bombs are, they tend however to cause flutter at present day Mach numbers. Therefore, the Bureau of Ordnance has sponsored the development, with Douglas and others, of the best aerodynamic brains of the country of a new series of streamlined bombs. These bombs are admirably suited to present day and foreseen future speeds. They require new systems of fusing and arming. Both the Navy and the Air Force have very large numbers of the World War II type bombs on hand. To make them usable under present conditions the Army Ordnance department has put into production a series of streamlined tails now coming into service.

Rockets have engrossed the attention of our research people to a great degree. We have developed, primarily at the big Naval Ordnance Test Station at Inyokern, an air-to-air rocket which has been appropriately titled the "Mighty Mouse" nicknamed after the potent rodent of the movie cartoons. The "Mighty Mouse" hits hard, and it can hit beyond the normal gunfire range of the target aircraft. This rocket is small enough to be carried in quantity in modern aircraft. It may be fired singly or in salvo. It is carried by new types of rocket launchers. We expect that the "Mighty Mouse" will be used extensively not only by the Navy but also by the Air Force, which participated in the service test and has ordered very large numbers of them.

It was at Inyokern that the RAM, a new anti-tank aircraft rocket, was developed, tested and manufactured in just twenty-two days. This weapon serves as an excellent example of inter-service cooperation.

In July, 1950, just after the Korean conflict broke out, our forces and those of our allies in the United Nations forces in Korea, were having serious trouble stopping the Soviet-built tanks with the weapons at their disposal. Shells and the old-type bazooka rockets were relatively ineffective against this heavy armor. Conferences were held at Washington between the Air Force and the Navy and plans were worked out for the development and production of a new rocket at Inyokern for use by both services. Air Force, Navy and Marine Corps pilots went to Inyokern to expedite the testing of the new weapon and to become familiar with its use. The Far East Air Force and the Pacific Fleet supplied transport to get the new rockets to Korea, to the fighting forces, with the least delay. In just twenty-two days from the time Inyokern was told to start work the station had delved into its vast stores of scientific knowledge, had built and tested models, had produced a pilot lot and had put it in the hands of our fighting aviators. The rest is history. RAMS in the air and new bazooka rockets on the ground made a fiery, exploding shambles of the Red tanks.

A great many other new aircraft weapons should come into service in the next two years. Then one will see results of years of hard work on research and development. There will be changes in armament commensurate with the improvement.

These advances in Naval "flying firepower," both those that are here today and those that are soon to come, are products of American genius and energy. END

A 1,000-pound general purpose bomb is wheeled to a waiting *Skyraider* on flight deck of the U.S.S. Boxer in Korean waters.

The Sixth Fleet gives Atlantic Pact Nations more Naval power in the Mediterranean than ever before as its air components guard the key to the safety of Southern Europe.

OUR CALCULATED RISK

LIKE OTHER U. S. operations in Europe, the Sixth Fleet is frankly a calculated risk. Critics claim that it is foolish to leave so many eggs in the narrow Mediterranean basket, where no point is more than 200 miles from land. If the Soviets overwhelmed and occupied Gibraltar and Suez, the Mediterranean would be corked tighter than a bottle of Napoleon cognac, and presumably the Fleet in time could be hacked to pieces by Russian airpower.

Admirals don't see it that way. In the first place, there are no major Russian airbases within easy striking range of the Mediterranean, and unless Stalin decides to make his test in Yugoslavia there won't be any. If Stalin is counting on long-range bombers, they can do two things:

They can come in high and try to hit the Fleet's swiftly maneuvering targets—something that was rarely possible in World War II. At such altitudes, they would be taking their chances with Sixth Fleet Commander Vice Adm. Mathias B. Gardner's F9F jet fighters. Or Stalin's bombers could come in low and face anti-aircraft guns that are vastly improved over the World War II variety and directed by radar that is similarly superior. It was not without learning that the U. S. Navy suffered the fanaticism of the Japanese Kamikazes. The Sixth's Senior Carrier Admiral, Cato Glover, was asked about the Fleet's chances. He thought for a long time and said: "If the Russians ever get some airbases in the Italian heel, we would really have something to worry about."

The Sixth Fleet has no home. It wanders the 2,330-mile length of the Mediterranean, from Gibraltar on the west to Beirut on the east, suspended like Mohammed's coffin between Europe on the north and Africa on the south. By refueling, rearming and re-provisioning at sea, it employs some of the most valuable techniques learned in the Pacific in World War II.

This is not to say that the Sixth Fleet never touches land—only that it doesn't have to. Hardly a week passes that some of its ships don't drop the hook at Naples, Genoa, Algiers, Istanbul or any one of 50 other friendly ports. The Fleet is too big to cram into any one harbor, even if that seemed advisable. Consequently, its ships—all with full wartime complements—are spread over the Mediterranean. In a typical week a cruiser is anchored at Venice . . . another cruiser and two destroyers at Bizerte . . . a light aircraft carrier and two destroyers at Tunis . . . two auxiliary ships at Casablanca . . . a big aircraft carrier and two destroyers at Leghorn, as well as two ships at Ancona, one at Patras, one at Syracuse, one at Naples, five at Gibraltar, and no less than 19 in the magnificent harbor at lackluster Augusta (Sicily). Two or three warships are always on hand at Southern Europe's current hottest spot, Trieste, just in case.

For the past four years the Sixth Fleet has usually consisted of an aircraft carrier or two, a couple of cruisers and eight to 12 destroyers. Recently the fleet's punch has been packed into a (CVB) carrier, a carrier of the Essex Class (CV), three cruisers and approximately 16 destroyers. Despite heavy commitments in Korea, the Sixth Fleet remains the apple of Admiral William M. Fechteler's eye.

In April, his flag flying in the CVB, Coral Sea, Rear Admiral Dan Gallery brought a task force past Gibraltar, a task force which considerably augmented the size of the Sixth Fleet. If the Soviets or their satellites start something, as some suspect they may, General Eisenhower will be comforted by the knowledge that he has more naval power in the Mediterranean than there has been at any time since World War II. In addition to his land-based air forces and army, he can call on Admiral Gardner's wide-ranging aircraft and a flock of five, six and eight-inch guns, plus more than 20,000 sailors.

In addition, the Fleet received last March a heavily reinforced battalion of well-trained Marines. During the height of the 1950 emergency, the Mediterranean lost a similar force when the Marine Battalion was sped through the Suez Canal and the Indian Ocean to help stem the Red tide in Korea. These new Marines are equipped with tanks and artillery. With proper air support from carriers and land bases the Marines say, naturally, they can hold any perimeter in Southern Europe—at least until this ancient sea freezes over.

The Sixth Fleet is surprisingly modern. None of its capital ships is old enough to have fought in World War II and most of the smaller ships which did fight against the Germans and Japanese have been reconditioned. It is said of a CVB that nine torpedoes striking simultaneously would be required to sink her. One officer, lost in the maze of compartmentation, said: "I'd settle for five if

they'd make it a little more comfortable."

After five years of pounding its beat in the Mediterranean, the Sixth Fleet's floating airfield of steel has gained, to the Soviet Government's everlasting chagrin, an international reputation for minding its own business, staying out of trouble, but always steaming within easy striking range of any free country that might suddenly feel the need of assistance.

The Mediterranean basin offers ample playground for war games in the very sight of people who need to see and occasionally feel the nearness of someone strong—someone who shares their ideals and faith.

The Sixth Fleet never harms, never fires a shot in anger, or even in protest, but it is capable of doing so and it is instantly available. Though it doesn't expect to fight, it stays in trim just the same.

The fleet rises early, usually long before dawn, to flex its muscles. Sometimes above the morning twilight's horizon one can see fingerlike gun barrels rising and falling and rotating like so many dance teams in rhythmic ballet; jets zipping off the flight deck, zooming over the horizon, swishing along at near-sonic speeds; heavier, slower, propeller-driven aircraft droning high in the sky in simulated search of submarines and enemy convoys; destroyers twisting and turning to the tune of make-believe sonar echoes—all day long, sometimes in the joint company of British and French men-of-war, the games continue, practicing combined gunnery, communications and tactics.

At night, before bedding down, a night security watch is posted over land and sea to make sure with its electronic eyes and ears that no unwelcomed or unidentified guests lurk in the shadows. Night pilots take distant lookout posts to warn of danger—all in training, of course, but darn good training.

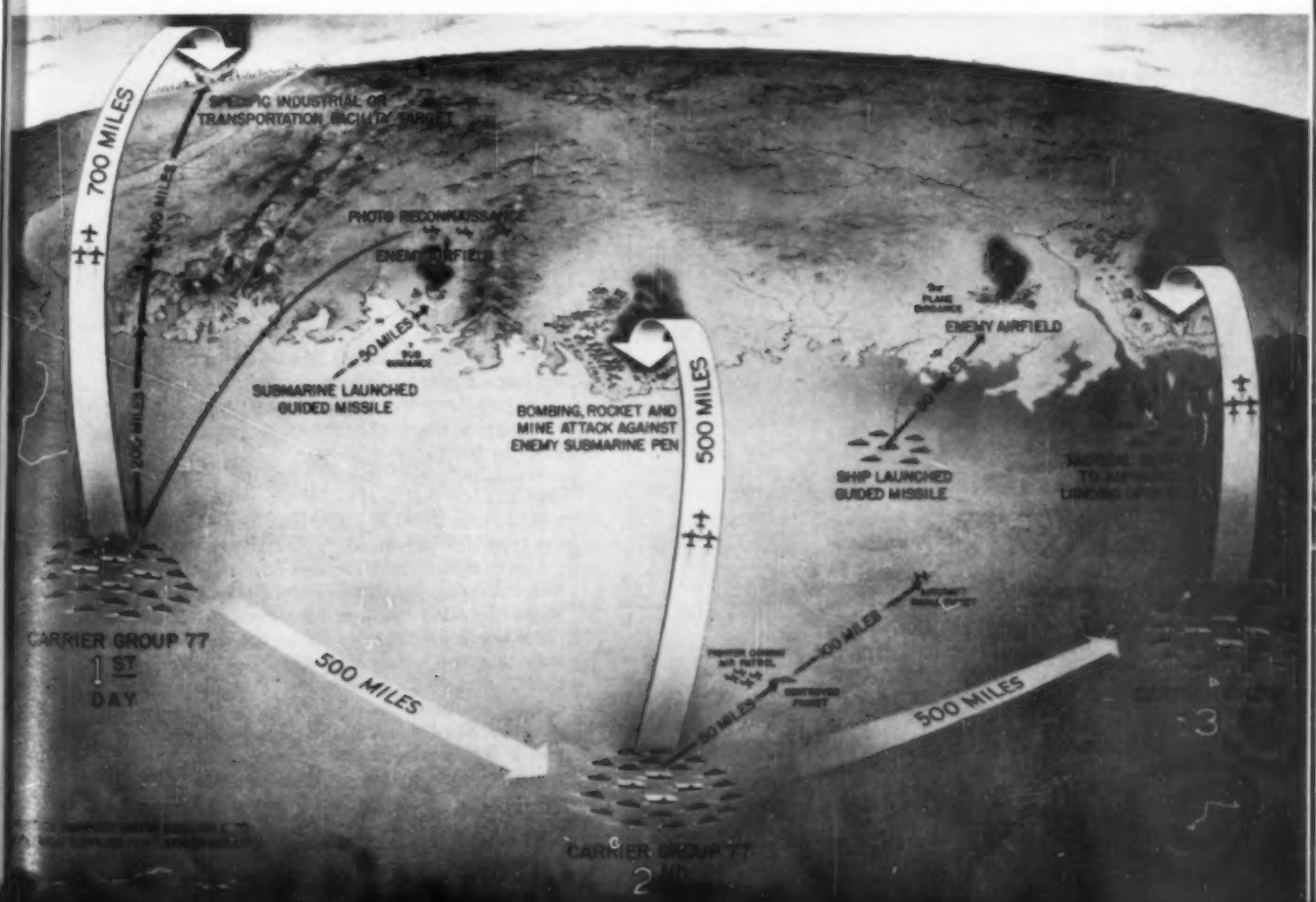
Then to punctuate such arduous training with refreshing periods of liberty and recreation the Fleet makes weekend visits to such historic cities as Istanbul, Athens and Naples, giving the crews ample opportunity to convert their month's pay into scenic excursions, native wares and wine samples—enhancing an already cordial relationship as well as the local economy.

Despite such friendly conduct over a five-year span, the Soviet bloc and Soviet sympathizers point to the Sixth Fleet as the symbol of "enemy" militarism, the imperialistic device for intervening in political arguments outside the domain of Uncle Sam.

Nowadays war in the "Med" seems far off—farther than it does from any Pentagon window—and Mediterranean sailors don't worry much. They spend over half their time drilling—in anti-aircraft fire, in anti-submarine warfare, in simulated air attacks and dogfights, in simply learning how to sail their complex craft.

In smaller and more dismal ports like Augusta and Corfu, only one-tenth of any ship's personnel may go ashore at any one time, as against one third in the others, and not even that many think it worth the attempt. Izmir in Turkey features wrestling between muzzled male cam-

Naval air power depicted arriving at an objective area, striking targets on three successive days and avoiding attack by changing position. The aircraft carrier is the mobile base for Naval air power and, as the main unit of a carrier group, possesses its own attack and defense forces. Air power is provided for the attainment of Naval objectives including destruction of enemy naval forces.



els. From Famagusta on Cyprus, one may motor to historic Salamis. Visitors to Athens are told in the ship's poop sheet that, "As strange as it may seem, it is against the law in Greece to dance." In Greece, even with the drachma at 15,000 to one, prices are fabulously high. They are low in the lovely Riviera ports.

Marriage between Americans and Mediterranean belles is discouraged. Anyway there are few opportunities for prolonged romance. Ships are rotated every five or six months and no sailor is likely to make the same port twice during a single tour. Nonetheless, at most ports there are dozens of girls waiting to greet the U. S. sailors, in English, like old friends.

A message from the Sixth Fleet commander says and means: "It is of utmost importance that all personnel conduct themselves in a manner which reflects honor upon the uniform they wear and the country they represent. An earnest conscientious effort on the part of all hands is constantly required." Rarely is any man over-leave; the penalties are severe.

"In general," says the Roanoke's Chaplain, C. C. Hartnug, "the men behave exceptionally well, even if not as well as their mothers might expect."

In most ports the Fleet is heartily welcomed, and not just because the sailors distribute three or four million dollars annually around the Mediterranean and don't break many chins. The natives seem genuinely glad to see the Fleet because it represents a powerful deterrent to Communist aggression. A 45,000 ton CVB, which "would reach to the 72nd floor of the Chrysler Building if stood on end," or a 15,000 ton "light" cruiser, makes an imposing sight when anchored offshore, and the average Neapolitan and Athenian seem to the sailors to take some comfort from such a sight.

The Communist mayors of cities like Venice and La Spezia stonily refuse to make (*Continued on page* 155)

A hearty welcome usually awaits men of the Sixth Fleet when they drop hook at some friendly port in the Mediterranean.

DIVEBOMBING COMMIES

by Lieut. Marion Gallagher

The author holds three Distinguished Flying Crosses and 13 Air Medals. He flew 71 missions in Korea as a member of Carrier Air Group Five, and was the first Naval aviator to shoot down a Russian MIG-15 jet fighter.

OUR GREATEST sport in Korea was armed reconnaissance. I'd turn the flight lead over to the section leader with instructions to maintain about 3,000 feet and keep me in sight. Then, I'd take my AD *Skyraider* down close to the deck. Camouflaged enemy vehicles were easier to spot at treetop level or less. That was a tough job at best in Korea, for the Commies were masters at camouflage.

After about my 30th mission I was suspicious of everything I saw; of every odd shape and discoloration. I double-checked my hunches. Once a camouflaged vehicle is spotted, it pays to do some more checking for the military invariably travels in groups.

Nothing is more disgusting to a divebomber pilot than to drop a heavy bomb on a locomotive and then have a big juicy tank rear its ugly head. Too many times in the beginning we'd drop our payloads on inviting targets and then find some that were more important.

We learned, too, never to lose sight of a target once we'd found it. Just once I let two tanks get out of sight after I'd run out of ammunition. I went away to get some help and was back in less than five minutes, but the damaged tanks had escaped into a woods.

Fortunately, the Chinese and North Koreans were never as good with their anti-aircraft gunnery as they were at camouflage. But they learned a few things too as the war went on. Dive-brakes are mighty fine to slow down your divebomber and increase accuracy in dropping bombs, but when flak gets accurate a divebomber has to learn to hit without them.

We usually started our bombing runs from about 15,000 feet and made our releases anywhere from 3,000 to 1,800 feet, depending on the type of bomb used.

I can't talk about divebombing without getting in a plug for the plane we used, the AD *Skyraider*. It's the best single-engine attack plane made and carries about the same bomb load that the old four-engine B-17 Fortress did. A typical *Skyraider* load as it leaves the carrier's catapult is two 500-pound general-purpose bombs, a napalm bomb, 16 rockets and a full load of ammo for the two 20mm machine guns in the wings. The AD isn't a bad fighter either when it gets rid of its load.

BOX SCORE

From beginning of Korean War through August 31, 1951, Navy and Marine carrier planes have flown 53,208 sorties in Korea. In addition, shore based Navy Patrol Squadrons have flown 6,409 sorties and Marines operating ashore have flown an additional 32,055 sorties. Incomplete figures for British naval aircraft: 4,963 sorties.

CUMULATIVE NAVAL DAMAGE REPORT

In the course of the above sorties (not including shore-based Marine) Navy and Marine fliers have compiled this record:

—destroyed	83 enemy aircraft and damaged	86 more
—destroyed	77 ammunition dumps and damaged	4 more
—destroyed	299 artillery positions and damaged	293 more
—destroyed	393 bridges and damaged	1,115 more
—destroyed	15,225 buildings and damaged	2,315 more
—destroyed	234 locomotives and damaged	268 more
—destroyed	321 machine gun and mortar positions and damaged	79 more
—destroyed	2,067 railroad cars and damaged	4,010 more
—destroyed	3,935 trucks and vehicles and damaged	2,390 more
—destroyed	1,019 warehouses and damaged	583 more

AND

An Estimated 45,700 Enemy Troops Killed

DESTROYED....15,225 Buildings

Based on analysis of about 16,000 close air support sorties flown against targets assigned by air support controllers, it has been found that Navy and Marine aircraft average six bombing or strafing runs per sortie while spending an average 1.3 hours on station at the target area. The average for carrier-based aircraft has been slightly higher, for Marine land-based aircraft, slightly lower. Approximately three percent of air support sorties are flown by jet fighters, 82 percent by conventional (piston-engine) fighters, 15 percent by conventional attack aircraft.

Naval aviation was born in 1911 with first shipboard landing and it has been skyrocketing for forty years.

LOOKING BACK

EARLY IN NOVEMBER, 1910, a small detail of enlisted men, under the direction of Naval Constructor William McEntee, worked feverishly to win for the United States Navy the distinction of being the first to launch an airplane from the deck of a ship. The Germans had announced their intention of doing just that. The Navy did not possess a plane but that enterprising Yankee, Glenn Curtiss had sent his star pilot, Eugene Ely, to Norfolk to help out.

On November 14, McEntee had a platform ready on the cruiser *Birmingham*. Ely, not daring to risk further delay, determined to make the attempt even though weather conditions were far from ideal. Taking off downwind and with a light rain falling, Ely's "aeroplane" dipped low toward the water, so low that its wheels actually touched before it rose again and flew away to land safely upon Willoughby Spit.

The United States Navy, in 1910, was busily engaged in adapting new technology to naval operations in the form of better propulsion, improved guns, more powerful explosives, wireless telegraphy, underwater craft and more accurate fire control.

Even before the Wright Brothers made their first flight individual naval officers had speculated on the possibilities of aircraft and their relation to warfare at sea. By September 1910, the Navy Department had assigned an officer, Capt. Washington Irving Chambers, to learn about aeronautics. It was he who had arranged for Ely's flight.

On January 18, 1911, Ely improved on his original feat by landing, as well as taking-off on a platform built on a ship. The ship was the armored cruiser *Pennsylvania*, anchored in San Francisco Bay. A month later Curtiss brought his "hydroaeroplane" alongside the same vessel and was hoisted aboard.

This convinced the Secretary of the Navy, George von L. Meyer, who asked Congress for a sum of $25,000 to purchase aircraft. In the meantime, Glenn Curtiss had offered to train a naval officer to fly—free of charge. Chambers selected Lieut. T. G. Ellyson, who thus became Naval Aviator No. 1. The "Air Navy" started when the first plane was ordered from Curtiss, on May 8, 1911.

It is perhaps an axiom in naval circles that Marines can usually be counted on to take care of themselves. All Marine flyers are trained as naval aviators and are always ready to operate either with their own Corps or with the Fleet. You may be sure that in all the developments hereafter set down, the Marines played their part and played it well.

Just how elementary some of the problems were appears in the first American safety belt devised by the then Lieutenant Towers (Naval Aviator No. 3) as a result of naval aviation's first fatal accident. The pilot, Ensign W. O. Billingsley, fell from the plane. Towers, his passenger, clung to a strut during the 1,600-foot plunge to the waters of Chesapeake Bay.

Among Navy's first pilots were Lts. Towers (left) and Ellyson, shown here in a Curtiss pusher biplane.

Another line of development sought means of launching aircraft from the deck of a combatant vessel. Chambers discarded Ely's solution of a special deck because it impaired the usefulness of the guns. Holden C. Richardson as well as others managed to build a workable catapult. In January 1913, the aviators went to Guantanamo Bay for the Fleet's winter maneuvers. They demonstrated the possibilities of aircraft, took over a 100 officers for hops; and thus interested many who soon applied for training.

When the newcomers reported, they found the way prepared. On January 10, 1914, the Navy Department issued a press release containing significant words:

"The Secretary of the Navy has decided that the science of aerial navigation has reached that point where aircraft must form a large part of our naval force for offensive and defensive operations. This country has not fully recognized the value of aeronautics in preparation for war, but it is believed that we should take our proper place."

with the intricacies of aircraft engines and equipment.

James V. Forrestal, Secretary of the Navy and first Secretary of Defense, was a naval reserve aviator of World War I. So were two future Assistant Secretaries of the Navy for Air, David Ingalls and Artemus L. Gates, and two Assistant Secretaries of War for Air, F. Trubee Davison and Robert Lovett, the latter currently the new Secretary of Defense.

The principal naval operations of the war involved the suppression of the submarine menace and the safe convoy of supplies and men to the European battlefield. In aviation this led to concentration on flying boats capable of long over-water patrol flights.

In antisubmarine warfare it is desirable to destroy the enemy, but it is almost equally useful if he is forced down and prevented from launching his attacks. For this latter purpose the aircraft of 1917-18 proved singularly effective. Naval aviation became the largest single component of the United States Naval Forces in Europe.

It appeared logical to bomb German submarine pens, thus cutting off the U-boats at the source. When the acquisition of land-based bombers for this purpose by the Navy caused certain eyebrows to rise, Admiral Sims replied with cogent logic:

"The mere fact that we as sailor (*Continued on page* 155)

R-6-L drops torpedo (above) in modern warfare, 1920 style. In 1928 the first landing was made on deck of U.S.S. SARATOGA (below).

The first and most compelling evidence of the new policy was the Naval Aeronautic Station at Pensacola, Florida. At first, it was no more than an abandoned Navy yard which the aviators literally fixed up with their own hands. Pensacola since has become one of the world's great air training centers.

Even in its primitive state, naval aviation demonstrated its ability to participate in naval operations. When revolutionary troubles caused President Wilson to order naval vessels to various Mexican ports for the protection of American lives and property, naval air units went along. Flying over Vera Cruz on reconnaissance, Lieut. P. N. L. Bellinger's plane returned one day with several bullet holes. This was the first United States aircraft to receive damage from hostile action.

Scarcely three years later, naval aviation found itself deeply involved in a full-scale war. Many of us today tend to overlook the impact and lessons of World War I. In the sudden expansion of naval aviation, which percentage wise exceeded that of World War II, much was learned that proved of value in the 1940's: 1. the ability of the automotive and allied industries to convert to the manufacture of aeronautical materials, 2. the source of splendid pilot material in the colleges and universities, 3. the ingenuity of American boys from farm and city when faced

Only 20 years ago, this T4M-1 was the most modern of the carrier-based planes. It best attests to aviation's rapid progress.

AIR NAVY'S QUARTERBACK

By Vice Admiral
JOHN HOWARD CASSADY, USN
Deputy CNO (AIR)

Vice Admiral Cassady

TO THE stranger who approaches it for the first time, the Navy Department appears to be a confused and sprawling institution composed of numerous bureaus and offices scattered among several buildings. On examination, it is possible to distinguish three general levels of activity and these are recognized by law.

First, there are the civilian secretaries; second, the Chief of Naval Operations; and third, the technical bureaus. The Secretary of the Navy and his assistants handle the highest level functions and are much concerned with relations between the Navy and other agencies of government; with questions of production; and with industry in general. Technical bureaus, on the other hand, supervise the development and procurement of the equipment and provide many special services.

The chief military officer of the Navy is the Chief of Naval Operations. It is he who commands the operating forces and our ships and aircraft. He also is responsible for their use, including their training, preparation and readiness for war. He determines what people and what material are required. He tells the Bureaus where and when they are needed. As Chief of Naval Operations, he is the Navy member of the Joint Chiefs of Staff and serves as Chief Naval Advisor to the President, the Secretary of Defense, and the Secretary of the Navy. He also is Naval Executive to the Secretary of the Navy for the conduct of the Naval Establishment.

It is obvious that no one man can possibly carry out all of the duties given to the Chief of Naval Operations by law. He cannot delegate his position as a member of the Joint Chiefs of Staff or as Naval Advisor and Naval Executive. Those things he must do himself. However he may assign other functions to deputies to carry on in his name. Congress has recognized this situation and authorized the establishment of up to six deputy chiefs of naval operations to perform such duties as may be assigned. In practice, five have been found a sufficient number. They are concerned respectively with Personnel, Administration, Operations, Logistics, and Air.

Of these five, the Deputy Chief of Naval Operations (Air) was the first to be created and his appointment grew out of the great expansion of aviation in World War II. Previously the Chief of the Bureau of Aeronautics had acted as aviation advisor to the Chief of Naval Operations. He had acquired many functions in regard to logistics, personnel and other matters not usually found in a technical bureau. The tremendous volume of production, procurement and maintenance of aircraft and equipment increasingly occupied the Bureau's efforts. While at the same time, the growing importance of aviation made its effect felt in every phase and area of naval operations.

To permit the Chief of the Bureau of Aeronautics to concentrate on his material functions and to place an aviation advisor closer to the Chief of Naval Operations, the Security of the Navy, on August 18, 1943, appointed Vice Admiral John S. McCain as the first Deputy Chief of Naval Operations (Air). They transferred many planning, personnel and logistical functions from the Bureau.

Admiral McCain found himself responsible first for working out a program that would insure adequate provision for and continuing support of the naval aeronautical organization. Second, he insured the best possible preparation, training and readiness for aviation units before they reported to Fleet commands. These functions have remained basic ones for all his successors in that office. He also acquired certain other duties of a Navy-wide nature to which have been added others with the passage of years. From the nature of his position Admiral McCain also became advisor to the Chief of Naval Operations on all matters pertaining to aviation.

On the basis of wartime experience, the Deputy Chief of Naval Operations (Air) has organized his office into six divisions. Their titles go a long way toward explaining their functions. They are Aviation Plans and Programs, Air Warfare, Aviation Personnel, Flight, Marine Aviation and Guided Missiles. These divisions with their military and civilian personnel are now lodged in the Pentagon where they work close by the other services and the Joint Chiefs of Staff.

Working with the Naval Aviation program both on the short and long-range basis is the responsibility of the Aviation Plans Division. Now this program is a complex thing. In the first place, a balance must be maintained between ships, bases, aircraft, and personnel. The bureaus must be told what numbers of each will be needed, as well as where and when. It is hard enough to work out such a program even under ideal conditions. But when war shortages occur; bottlenecks appear in production; the

enemy does not always behave as expected—adjustments and changes have to be made.

In peacetime, new developments, changes in the budget and fluctuation in the international situation all have to be taken into account. Any program for Naval Aviation has to be carefully fitted into the program for the other elements of the Naval Establishment. In this field alone, the Deputy Chief frequently has to solve some difficult problems. The success achieved in World War II and the rapidity with which naval aviation responded to the outbreak of hostilities in Korea indicate that the general program was sound.

In case of war, it is imperative that the Naval Aviation Forces have thorough training and preparation. Both men and material must be in the highest state of readiness. Carrying out this responsibility falls to the Air Warfare Division. From the operating forces comes experience along with all sorts of suggestions for new weapons, training methods and tactics. These have to be carefully studied and their value assessed.

For example, a fleet commander may indicate the requirement for a particular type of aircraft capable of greater performance than any currently available. The problem is studied by experts in Air Warfare and, if the need seems justified, the Deputy Chief of Naval Operations (Air) directs the Bureau of Aeronautics to undertake the necessary design studies and to negotiate with contractors.

An inventor may come up with a device which will enhance the effectiveness of Naval aircraft. Air Warfare studies its possibilities and, after consultation with Fleet commands, develops tactics and doctrine for its effectiveness.

On the basis of experience, training methods and tactical doctrine are devised. It is important that they be uniform throughout the Navy. During the last year the carrier *Leyte*, with its Air Group, was ordered without warning from the Mediterranean to Korea. Its success in operating with the ships of the Pacific Fleet underlined the reason for standard training and doctrine.

The Aviation Personnel Division becomes concerned with a young man when he shows his interest in Naval Aviation. It may be as an airman, an aviation cadet or, perhaps, an officer already commissioned who wants to be a pilot. First, it provides for adequate instruction through the Naval Air Training Command. For those who have the qualifications and the desire to fly, there exists a series of flight schools from which a successful candidate will emerge proudly wearing the gold wings of the Naval Aviator. The enlisted airman has a wide range of schools and specialties to which he may be sent according to his qualifications and ability.

Even after the officer or enlisted man leaves his course of instruction, the Aviation Personnel Division follows his career. He is assigned according to a well thought-out routine of alternating periods of sea and shore duty. He is watched over for further education and advancement. The Division recommends to the Bureau of Naval Personnel where officers should be detailed and the number and varieties of aviation rates to be furnished to ship and shore activities.

Aviation has become an all pervading business. Those who use the air, like those who use the sea, have to learn to get along together and to adopt a good many rules to insure their own well being. The Flight Division represents the Navy in its dealings (*Continued on page* 142)

Naval fighter pilots at every battle front, like every man from seaman striker to Fleet Commander, carry out signals called by the CNO.

CLOSE AIR SUPPORT

SEMPER FIDELIS

Chinese Communists are running head-on into one of the UN Forces' toughest weapons—close air support as practiced by the Marine Corps.

A Marine Corsair fighter on close air support duty in Korea zooms skyward through smoke after dropping Napalm on Red concentration. On the opposite page is the Marine forward controller who called in the air strike against the strong enemy-held ridge.

A CHINESE COMMUNIST counter-attack in Korea was well underway against Marine infantrymen when four Marine *Corsairs* soared overhead and the air controller started barking directions for an aerial assault on the Reds.

"It's that ridge to the north of our panels," he explained. "They've been assembling there. More than 100 are coming at us now."

The directions were short but Marine airmen of the famed "Black Sheep" squadron caught the urgency of the ground situation and peeled off into an attack formation. Diving run after diving run was aimed at the enemy-covered ridge. The flyers released their bombs that exploded among the Chinese. They aimed their rockets and machinegun fire at the Communists crawling along the ridge. Some Reds were hit within 100 yards of the friendly infantrymen.

Capt. John Perrin of Kirkland, Wash.; Capt. William T. Witt of Santa Ana, Calif.; 1st Lt. Kenny C. Palmer of Montclair, N.J.; and 1st Lt. William Harris of Bedford, Ind., were given credit for breaking up the Chinese attack.

Whether these Chinese knew it or not, they had run head-on into one of the Korean War's most lethal weapons . . . Marine Close Air Support. Perfected in peacetime, the Leatherneck brand of aerial striking force has reached its most effective peak in Korea. "CAS," as Marines call it, has placed at the disposal of the infantry leader an added weapon he can hurl at the enemy.

Soon after the fighting started, the 1st Provisional Marine Brigade landed in South Korea. They brought with them the 1st Marine Air Wing's Forward Echelon of fighter-bombers commanded by Brig. Gen. Thomas J. Cushman, as well as their CAS team.

A number of Marine aviators accompanied their Marine infantrymen as they moved into the battle of the "Pusan Perimeter." These were the forward air controllers who would live with the ground troops. From their observation posts at the front lines they would direct the attack of ammunition-loaded aircraft on enemy positions.

Infantrymen soon learned that Marine aviation could hit enemy troops, weapons and supplies that neither artillery nor mortars could reach. The reverse side of a hill "sanctuary" became a popular target for air attacks. The napalm fire-bombs soon seared a burning impression on the North Koreans as its molten fire splashed out over troop concentrations, tanks and supply buildings.

Another part of the CAS team set up a tactical air control center not far behind the Marine front lines. They were the radio link between the forward air controllers and the planes. A clearing house of requests for fighter-bombers, this control center assigned flights to areas along the fighting front. Then, controllers took over radio direction on specific targets.

Two Marine squadrons and their F4U *Corsairs* operated from the decks of two "jeep" Navy aircraft carriers. Another Marine squadron of night-fighters started after-dark raids on the enemy from a base in Japan.

In the first month's operation from the carriers, Marine pilots from the "Black Sheep" and "Death Rattlers" squadrons massed over 4,000 combat hours of flying.

mostly around the "Perimeter." In the landing at Inchon, Leatherneck pilots from the same two squadrons lashed the landing beaches and other nearby enemy installations prior to the infantrymen's hitting the shore. CAS then went into action as the Marine ground troops moved inland, past vital Kimpo airfield and into the fight for the capital city of Seoul.

The freeing of Kimpo opened the door for the operation of three more Marine squadrons that had arrived shortly before from the "States." Within hours after the field had been taken, the "Devilcats," "Checkerboard" and an F7F *Tigercat* night-fighter squadron flew to support infantry units fighting near Seoul. Maj. Gen. Field Harris had, by this time, assumed active command of the 1st Marine Air Wing.

It was in Seoul that two Marine buddies—one on the ground and the other in the air—teamed up to slip a couple of well-placed rockets through the windows of a building on a surprised Communist Command Post.

Slugging their way through the old capital city, Marine infantrymen were held up by a massing of Communist troops on a hill overlooking a railroad yard. Capt. Robert B. Robinson of Orange, California, a forward air controller with the troops, and other Marines saw a group of the enemy hurrying into two buildings. They soon learned this was the command post of about one to two thousand troops.

An HTL-4 helicopter shows how communications line is strung between a gun crew and the control center in a combat area.

The forward observer then put in a call for an air strike on the buildings and proceeded to talk an F7F *Tigercat* into the target.

"Follow the river along the tracks," he instructed. "When you get to the rail yards, you'll see two tall buildings with a short red one in the center. Your target is the two tall buildings."

The pilot "Rogered" for the description and the observer recognized the voice as belonging to his friend, Captain Lang of Stratford, Conn. Before the Korean War, these two had been squadron mates.

To make sure he had spotted the right buildings, Captain Lang let loose a short burst from his machineguns on his first pass at the area. Observer Robinson told him he had the correct target.

The next time around, Captain Lang dropped down to almost treetop level and headed for the north building.

"There were only three windows in the wall facing the on-coming plane," the observer said, "and Lang sent a rocket through the middle window."

On his next pass at the target, Captain Lang sent a rocket screaming into the other building.

"We were lying on a hill only about 500 yards away and could see the shooting well." Captain Robinson explained, "Those buildings really burned when those rockets exploded inside."

For advancing Marines, other infantrymen and the 1st Marine Air Wing, the Korean War has been ridge after ridge. East of Hoengson, Marines on the ground and in the air set many a group of Chinese troops running from one hill to another in this type of maneuver.

Marine flying activities haven't been limited to daylight action. In their radar-equipped fighter-bombers, Leatherneck pilots have answered the urgent night calls from ground units for help in stamping out both enemy fire and mass troop attacks.

Accompanied by a flare plane over a highway in North Korea, Marine Capt. Art Wagner of Chino, Calif., was on a routine truck-hunting mission. He heard on his radio: "Flare plane two . . . flare plane two . . . we have an urgent target north of Seoul. Send your little friend over here!"

By "little friend" the radio voice meant Wagner's fighter-bomber.

The Marine poured on the speed with his radar-installed *Corsair* and reported over the Seoul area. There he found another plane dropping bright parachute flares over a battle-line flaming with artillery shell bursts and red tracer bullets. Bouncing off the clouds in the sky were the piercing lights of a searchlight battery. The lights reflected perfectly on a valley below where a large force of Chinese were massing for an attack.

Then, the roar of Captain Wagner's plane was heard by the Army ground controller. He gave the flyer a description of the front where the enemy could be hit.

"Fly along the river until you come to a railroad bridge," the controller said. "On the west side of the river is a clump of trees. In the trees are about 500 Chinese."

Captain Wagner dove down at the clump of trees and fired a short burst with his 20 mm machine-cannons.

"That's right. You've got the area spotted," the controller directed. "Now give that wooded area all the napalm you've got."

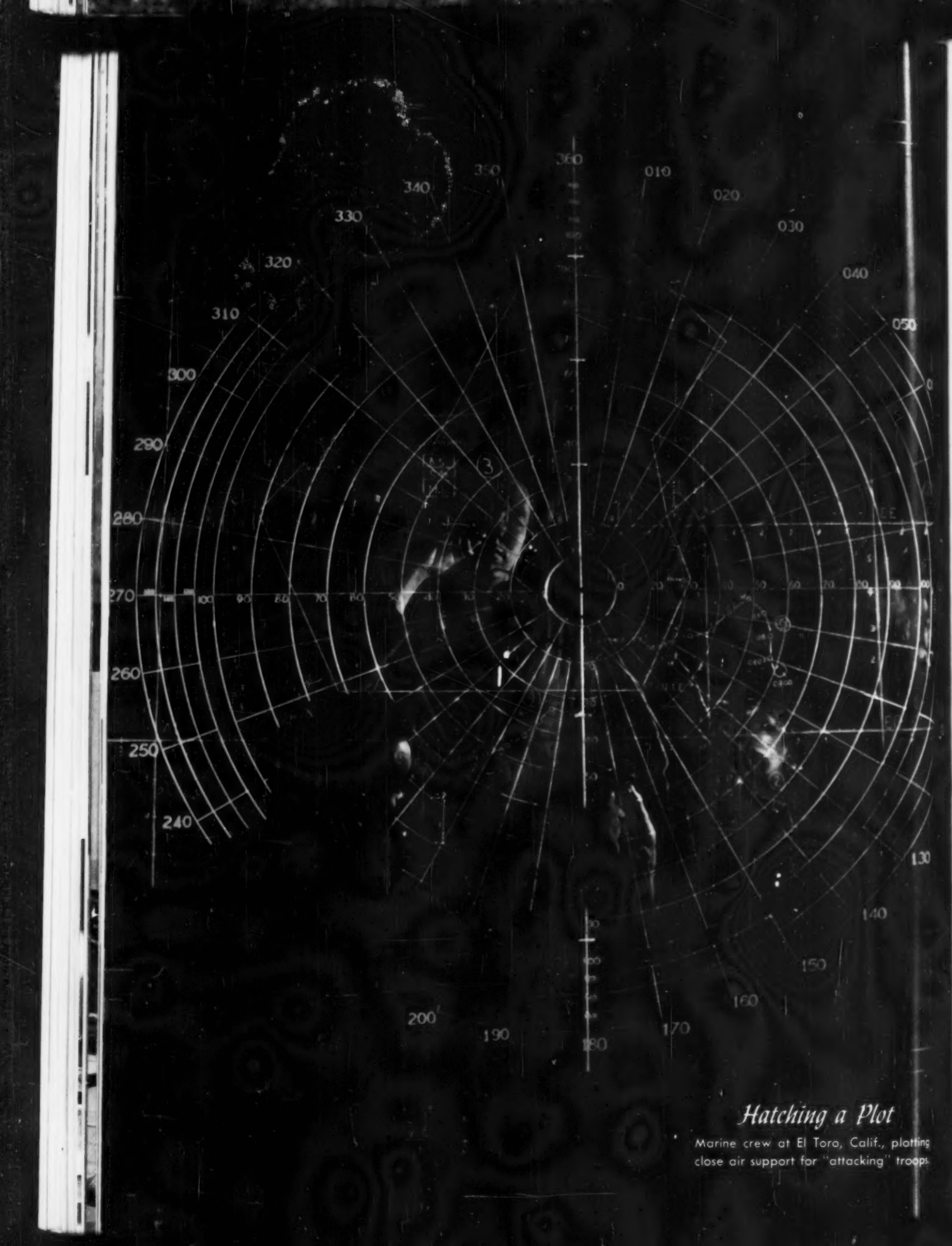
The Marine went into another dive and released his napalm. The fiery, molten fluid exploded and covered about one-half of the woods. He dropped two bombs which exploded in the middle of the trees. Next, the Marine flyer went into a number of (*Continued on page* 176)

Jet Bird at Rest

Back from a mission, a Marine Panther receives a routine gear check aboard the big flat top.

In the new concept of amphibious warfare, light carriers are the new attack transports, and big helicopters are the landing craft. HRP-1 'copters here bring guns and men to the front in a typical demonstration of vertical envelopment.

Members of a 75 mm. howitzer crew rush to assemble their gun seconds after it settles to the earth, and then (below) man their weapon as the HRP-1 helicopter moves away carrying a "casualty."



Hatching a Plot

Marine crew at El Toro, Calif., plotting close air support for "attacking" troops

Marines disembark in 20 seconds to gain a firm foothold on a beach head during maneuvers to demonstrate the effectiveness of helicopter assault.

Vertical Envelopment

Helicopters are being integrated with landing forces in new idea of assault from the air.

BIGGEST ambition of the Marines is to have available sufficient helicopters so Landing Forces will have the capability of conducting the main effort of an amphibious assault with helicopters in vertical envelopment. The ship to land movement will principally be one of helicopter air transport. The limitations on the aircraft are of necessity exacting; the most critical of these being their physical size.

Marines will always be called upon to protect American interests overseas, intervene in situations short of war, or to spearhead an actual invasion in the prosecution of a war. To cope with this, Marine units must be mobile, flexible, and versatile. Therefore, helicopter squadrons must be initially carrier-based and integrated with the Landing force, and its combined arms and supporting tactical aircraft. Stowage requirements, size limitations and payload capacities will govern the number of them committed for any specific operation.

With the development of the larger capacity assault helicopters and with an increase in squadron numbers, portions of the ship to land vertical envelopment concept will be tested and evaluated until sufficient helicopters are obtained to make the main effort of an amphibious assault. Then will culminate the efforts of those Marine Corps officers who in 1946 undertook the development of a concept for ship to land transfer of the Landing Force that would survive an atomic blast and negate enemy beach defenses.

Through the continuous efforts of Marine Helicopter Squadron HMX-1 at Quantico, Virginia, Marines have been able to prove to themselves that employment of helicopters en masse is feasible. Flight deck procedures for operating large numbers of transport helicopters on repeated flights from a carrier at sea have been successfully developed. Instrument flights, formation flying under full load conditions and mass formation landing of these helicopters in rough terrain has been demonstrated numerous times.

Externally slung howitzers and other supplies and equipment have been transported and delivered from a hovering position, even with obsolete type 'copters. The future is indeed bright for the Marines equipped with the more modern craft. Helicopter-borne Landing Forces will be the air cavalry of the future amphibious operation.

As visualized now, an assault would begin upon order by the Attack Force Commander with the launching of assault troops in helicopters and amphibious vehicles from carriers and other ships in dispersed formation well at sea from the objective area. Enroute, the commander of the helicopter-borne assault force must be prepared to make decisions altering the landing plan, either as to the time or place, as circumstances require. However, thorough prior planning for alternative landing areas would be completed before becoming airborne in order to have properly integrated air support and naval gunfire should it be necessary to execute an alternative plan.

Specialized organization within the helicopter operating units will develop sound techniques for controlling the mass take off and landing on helicopter transports and in the objective area. Guidance of the helicopters by a central control organization will result in their maximum effective utilization.

Having successfully negotiated its way to the landing area, the helicopter-borne component would land behind the bulk of the beach defenses, where it would proceed toward accomplishment of three objectives: 1) the isolation of the beachhead by the seizure of positions on the beachhead line and by blocking or delaying the movement of enemy reserves; 2) the reduction or isolation and neutralization of enemy positions dominating the beach and its seaward approaches; and 3) the location of immediately accessible approaches to and across the beach.

Helicopter tactical formations would be determined primarily by the requirements of the tactical plan and secondarily by the limiting physical factors of helicopter handling and the technical characteristics of the guidance system used. The mobility and flexibility of the helicopter would be fully exploited during this phase in the rapid movement and reconcentration of forces, particularly to meet the threats of counter-attack.

The principal threats during the early phase in which the helicopter-borne troops are carrying the burden of the assault are those presented by enemy air, airborne counter-attack and mechanized counter-attack. The dispersion which characterizes the operation is in itself a considerable measure of protection against air attack. To further reduce the air threat and to counter the threat of air-borne attack, a strong cover of high performance aircraft is essential.

Provisions for meeting the threat of mechanized attack would be made by primary dependence on the utilization of mass weapons. Clustered shaped charge bombs, rockets, gunfire and incendiaries would destroy or break enemy concentrations by air attack. Ultimate dependence on helicopter-borne troops equipped with lightweight anti-tank weapons and anti-tank mines would fend off attempted penetrations.

The surface troop components, under cover of the successes achieved by the helicopter-borne troops, would approach and assault the beach in a conventional manner. They would effect a juncture with the helicopter-borne troops, and continue the reduction of enemy strong points within the beachhead perimeter.

Early logistic support would follow the pattern of the assault; helicopters delivering supplies to inland positions, and amphibious vehicles transporting material across the beach line. In the early phases of the assault, the mass of shipping would remain in a designated area, serving as a base of supplies from which cargo would be shuttled to the landing area by helicopter.

The remainder of the operation would follow the conventional pattern, except for the following difference: the Landing Force Commander would possess complete mobility for the bulk of his forces by using the helicopter; he could seize critical areas or key terrain features, particularly those that were lightly held or undefended; the enemy would be continuously confronted with the three dimensional attack.

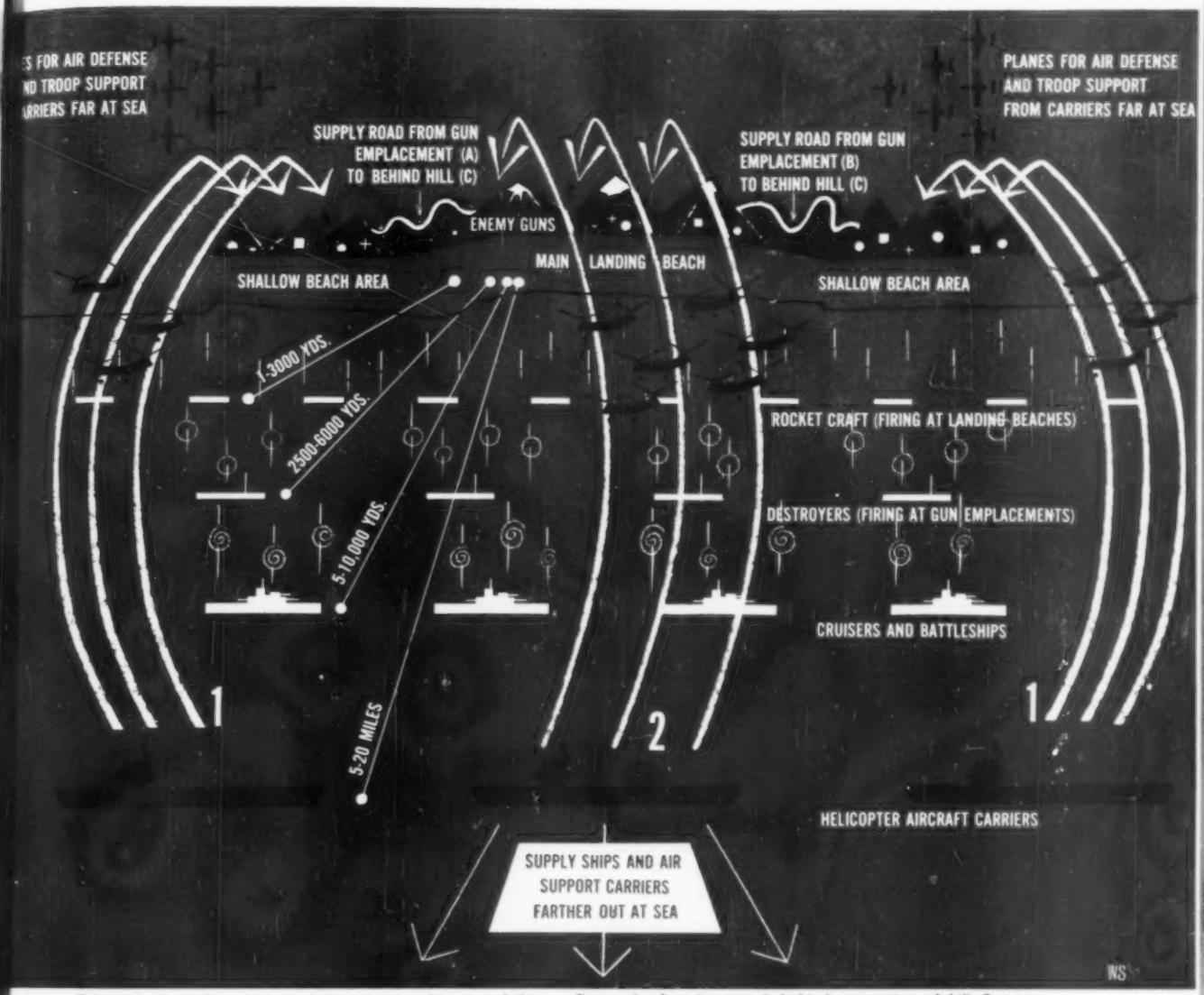
Second wave of helicopters brings guns and ammunition to troops delivered earlier by larger assault 'copters.

The military value of the helicopter-borne assault in amphibious operations is clearly evident from the following tabulation which contains the characteristics of such forces. Note that many of these are peculiar to this type of force.

1. Through the use of the carrier based transport helicopter, in conjunction with the extensive range and power of the Navy, it will be possible to initiate helicopter-borne assaults at the same range as the Fleet. This distance is far beyond the combat radius of conventional type troop carrier aircraft.

2. Landing of the troops and equipment in combat and organized tactical units is achieved. This permits immediate control by the troop leader over his men during the most critical period of the assault.

3. The World War II situation in which the attacker's power at the water's edge was a minimum and the defender's at its maximum can (*Continued on page* 142)



This illustration of vertical envelopment covers but one of the many possible tactical situations. First, carrier air strikes and naval gunfire work over the landing area. Then, as naval gunfire is shifted inland, air strikes hit landing areas with Napalm and anti-personnel bombs. As air strikes are completed, troop-carrying helicopters land at positions 1 and 2. Supply helicopters follow with heavy guns and ammunition. Troops landing in area 2 behind protection of hill C capture roads between enemy supply dump and gun emplacements on hills A, B and C, then attack enemy from the rear. Simultaneously flank attacks are being made from the No. 1 positions. After gun emplacements on A, B, and C are neutralized, surface landing craft use main landing beach. Carrier-borne aircraft keep control of the air throughout operation.

In actual combat, these troop-carrying helicopters on deck of carrier, will land troops behind enemy lines.

Bu Aer's Goal—

Skystreak, developed by BuAer with Douglas, set old world's record of 640.7 m.p.h. during test run at Rogers Dry Lake.

Navy doesn't sound off about speeds of new planes but when BuAer says, "Sound's aft," it means sonic barrier problems are behind them.

By Rear Admiral
T. S. COMBS, USN
Chief, Bureau of Aeronautics

NO DISCUSSION of the future of naval aviation or commercial aviation is complete without a glimpse into the possibilities of supersonic flight. A decade or so ago, such a view would have been obstructed by what was then thought of as the "sonic barrier," an imaginary wall of invisible but impenetrable compressed air which would well up and repel any aircraft attempting to intrude at a velocity greater than the speed of sound.

It was popularly feared that strange and terrible things might happen to a plane attempting to pierce this barrier. Scientists were concerned with the probability that very large changes in the forces acting on the aircraft might throw it completely out of control, with disastrous results at such speeds. That these fears were well founded was demonstrated when one of the early DeHaviland research planes disintegrated at high speed, killing Geoffrey DeHaviland, Jr.

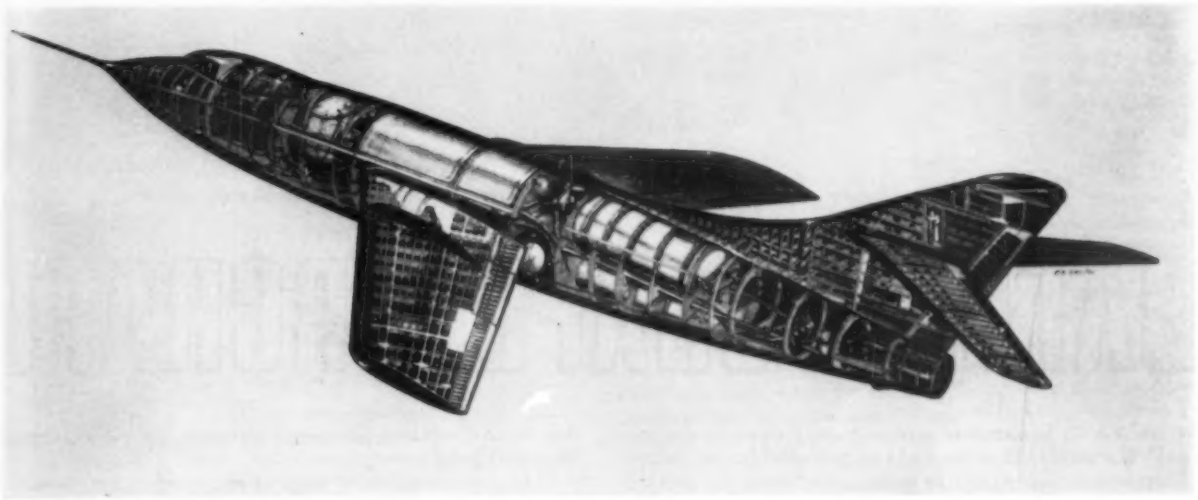
A vigorous program of research using wind tunnels, pilotless aircraft, and manned research aircraft has done much to dispel the mystery of the sonic region, and has provided information with which we can now confidently design aircraft to operate beyond the speed of sound.

Now that it is well known that we can fly at supersonic speeds, and have done so on many occasions, the only remaining barrier to open discussion of supersonic flight is that imposed by the necessarily strict security regulations. Actually, this barrier is a most formidable one, and only a small portion of the Navy's activity in this field can be disclosed. Within the security bounds, however, certain points can be set forth which should be of interest to the public.

It would of course be erroneous to assume that everyday operational supersonic flight is practicable as of now. Before tactical employment of supersonic combat aircraft, or commercial utilization of supersonic cargo or transport aircraft, can be achieved successfully, a great deal of experimental data must be accumulated on general aerodynamics, performance, stability and control, powerplant operation, structures, materials, aerodynamic heating, physiological problems, etc. It is toward the accumulation and digestion of such data, rather than the large-scale production of supersonic vehicles, that most of the Navy's effort is being directed. It is toward this goal also that the related and coordinated effort of the Air Force, the National Advisory Committee for Aeronautics, the aircraft industry and other interested agencies is being channeled.

Supersonic test facilities, most of which require huge initial capital investment and staggering operating costs, represent an expense which private industry can ill afford to bear. In these days of unsettled international condi-

SUPERSONIC AIRCRAFT



In effort to get further ahead of speed of sound D558-2 or *Skyrocket*, shown in phantom, was built as BuAer's research project.

tions, however, the armed forces cannot afford not to support these activities. Hence, the future of commercial as well as military supersonic aviation is largely dependent on the supersonic testing currently being conducted toward the development of combat aircraft.

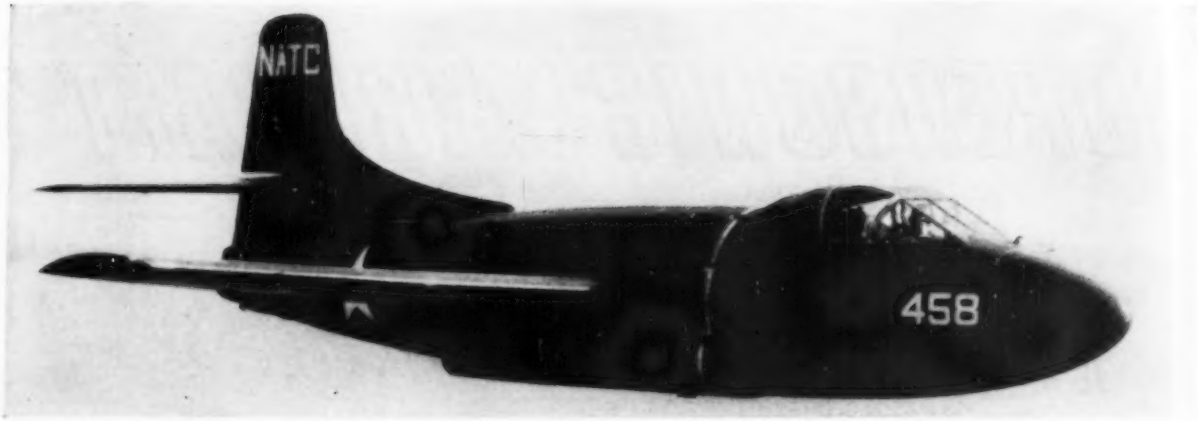
In this connection, the Navy operates supersonic wind tunnels at the Ordnance Aerophysics Laboratory, Daingerfield, Texas; the David Taylor Model Basin, Carderock, Md.; and the Aerodynamic Test Department, Point Mugu, Calif. Most of these facilities run regularly on a double or triple shift basis, and are still barely adequate to meet current demands. In addition to the wind tunnels, other vital facilities such as jet engine and rocket propulsion laboratories, guided missile firing stations, and various related activities are kept constantly busy.

The development of supersonic airplanes of military and economic usefulness hinges largely, of course, on the successful development of suitable power plants. The "sonic barrier" can be breached, but the propulsive forces required increase considerably; and, consequently, substantially larger power plants must be kept at reasonable values. It has been the successful development of jet propulsion power plants, in the form of turbo-jets, ram-jets, and rockets, which has made supersonic aircraft feasible.

For the low supersonic velocities presently being considered for piloted aircraft, major emphasis is on the development of the turbojet engine. The major problem is to provide suitable air inlets which will efficiently slow down the high velocity air to the reasonable values at which it may enter the engine. However, as the flight speed is increased, the power developed by the engine is increased, and the engine must be made structurally adequate.

At present, there are several turbojet engines available which are suitable for flight (*Continued on page* 141)

Navy plans fostered these tailless supersonic aircraft, F7U Chance Vought *Cutlass* twin-tailed jet (top) and Douglas' radical XF4D.



Built into a compact fighting package, the F3D is a fighter, attack, reconnaissance and long-range escort aircraft.

BATTLES SHAPE AIRCRAFT

THE NAVY has studied tactics, techniques and weapons of World War II in the light of probable future combat areas and has set out to reshape its forces to meet demands of those areas, just as it shaped them to meet the problems of island warfare between 1941 and 1945.

An outstanding example of the kind of change which is taking place is the emphasis now being given to anti-submarine warfare. The Navy has developed sensitive airborne detection devices to counter the menace of Russian submarines and that equipment is responsible for the guppy-like appearance of several modern Navy aircraft.

The postwar concept of patrol and attack planes and fighters has been partially demonstrated in Korea, where such aircraft have provided close support for UN ground troops, destroyed communications, transportation systems, and enemy troops.

In case of major war, they must be prepared to perform these tasks, to deny the sea to enemy shipping, and to assist other services.

While strategic and tactical considerations have dictated many changes in aircraft design, Navy sponsored technical improvements are exerting a revolutionary effect on aircraft. Turbo-jet, turbo-prop and rocket engines are gradually replacing the piston engines in practically all types of Naval aircraft. Improved armament, including gun and bomb sights as well as guns, bombs, rockets and air launched guided missiles, is giving the aircraft an unprecedented punch.

Electronic gear has paced engines and guns, and now airborne radar is as powerful as that carried aboard surface vessels during World War II. It can be used to detect enemy forces or to assist our own forces in escaping detection. The technical revolution encompasses practically everything that goes into flying—instruments, flying suits, oxygen systems, fuels and structural materials.

Perhaps the most spectacular phase of development comes under the heading of high speed reasearch. Even during World War II, operational airplanes occasionally reached speeds at which the controls refused to function as they were intended. Turbo-jet engines promised that flight at these speeds would become commonplace, so the Navy, the Air Force and the National Advisory Committee for Aeronautics concerted forces in a joint high speed research program.

Initial work included tests of radio controlled free-fall plane models, tests of "parasite" wing sections mounted in an area of high speed airflow on a "host" airplane and tests of sweptback wings on a conventional airplane. The NACA and the Air Force carried out other phases of high speed research and both Air Force and Navy constructed special aircraft for the NACA to use in a complete exploration of high speed flight phenomena.

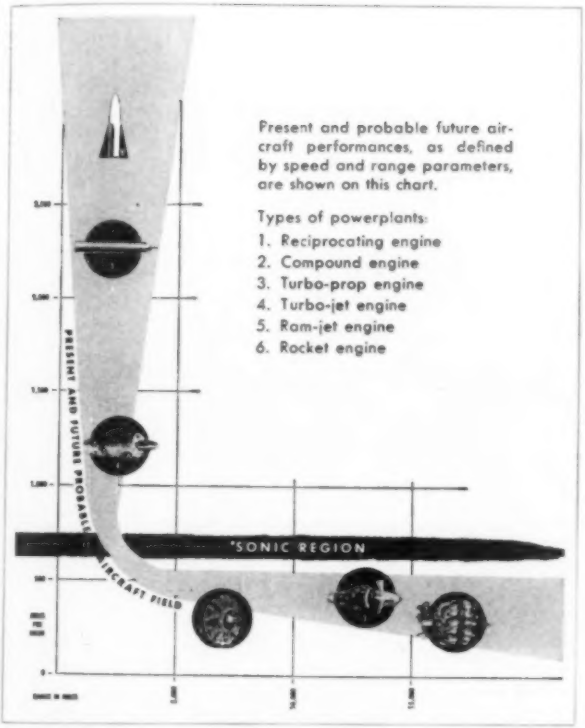
With the Navy's Douglas built *Skystreak*, Cdr. Turner Caldwell established a world speed record of 640.7 m. p. h. on Aug. 20, 1947, and Maj. Marion Carl, USMC, raised it to 650.6 m. p. h. five days later. The Air Force's X-1 was the first aircraft to exceed the speed of sound and recently the Navy's *Skyrocket* achieved a substantially higher Mach number than any other airplane has ever reached.

Not the least significant phase of high speed research has been the high degree of harmony which has prevailed in this phase of Navy-Air Force relations. The Navy conducted its initial tests of swept-back wings in a P-63 which it obtained from the Air Force. The Air Force then used the Navy modified P-63 to obtain data needed in the design of the X-1. Even more indicative of a high level of cooperation is the fact that a Navy designed rocket motor powered the Air Force's X-1 during its high speed flights.

Cooperation has been the heart of the high speed research program. The airplanes were built to determine aerodynamic data at specific speeds and altitudes and not simply to see which service could fly the fastest. Thus each of the records is an indication of how well the designers have achieved their aims and a symbol of a cooperative effort to extend the boundaries of aeronautical science.

The tangible results of high speed research are only now beginning to become apparent in combat aircraft. Such airplanes as the Navy's *Panther*, and *Banshee* and the Air Force's *Sabre* and *Thunderjet* were under construction or already flying when the *Skystreak* set its speed records. Even in these aircraft many refinements in design can be traced directly to high speed research.

Combat aircraft are the tangible results of high-speed research and the many practical lessons learned the hard way—in war.


Present and probable future aircraft performances, as defined by speed and range parameters, are shown on this chart.
Types of powerplants:
1. Reciprocating engine
2. Compound engine
3. Turbo-prop engine
4. Turbo-jet engine
5. Ram-jet engine
6. Rocket engine
PRESENT AND FUTURE PROBABLE AIRCRAFT FIELD
SONIC REGION

Research and engineering in engines in the whole field of powerplants are bringing new high speeds to today's aircraft.

Newer models that are now going into production will show even more benefits, but it is the designs which exist only on drawing boards or as visions in the minds of aircraft designers that will see the full advantages of high speed research.

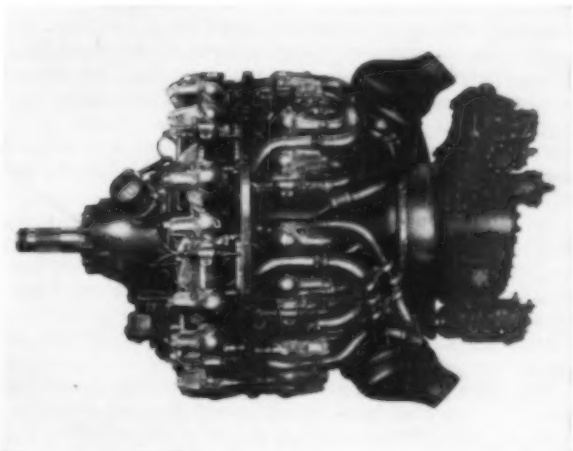
Since the close of World War II, many new Navy fighters have been powered by turbo-jet engines. This continues a line of development which began in early 1943 when the Navy contracted with McDonnell for the XFD-1, a turbo-jet engined fighter, and with Ryan for the XFR-1, equipped with both piston and turbo-jet engines. The XFR-1 served as a transition model which acquainted pilots and designers with the peculiarities of jet propelled aircraft and still provided the safety of proven engines. The XFD-1 served as a prototype for the modern *Phantoms*. Other jet fighters which were undertaken before the close of World War II included the Chance-Vought XF6U *Pirate*, the McDonnell XF2H *Banshee*, and the North American XFJ-1 *Fury*.

The achievements of these jet aircraft indicate the rapidity with which the Navy adapted them to its use. On July 21, 1946, a *Phantom* made the first landing and take-off from a United States carrier, the *Franklin D. Roosevelt*. Some fifteen months later Fighter Squadron 5A gained the distinction of being the first squadron to conduct routine carrier operations with jet propelled fighters, when it began operating from the *Boxer* and *Princeton*. The very fact that this operation was possible proved that the hazard of jet blast, the difficulties of high speed take-off and other problems which the Navy encountered when it began adapting jet fighters to shipboard operations either already were or soon would be solved.

The *Pirate* was the first operational jet fighter to be equipped with an after-burner which introduced fuel into the flaming exhaust gases and thus provided a power increase of 30 per cent for take-off and 50 per cent under best operating conditions. A photographic version of the *Banshee* demonstrated the jet fighters' ability to make high altitude flights when it took a picture of Washington, D. C. vicinity from an altitude of 50,000 feet.

Of these jet aircraft, the *Phantom* and the *Banshee* were the only two which have a family resemblance to each other. A comparison of the characteristics of these two aircraft reveals the enormous strides that Naval aviation has made since the close of World War II. Airplane development has been accelerated so that speed and armament improvements which should have taken a decade prior to World War II were compressed into the two years between January, 1945, when the *Phantom* made its first flight, and January, 1947, when the *Banshee* first took to the air. This improvement was characterized by the change from four 50 caliber guns in the *Phantom* to four 20 millimeter guns in the *Banshee*, a 5,000 foot increase in operating altitude and a speed increase of over 100 m. p. h.

The *Phantom*, the *Banshee*, the *Fury* and the *Pirate* all served their major purpose by defining the problems that the Navy faced in making jet propelled fighters a part of its striking force. The *Phantom* has gone through a number of modifications and is still one of the finest fighters in the world. However, by and large it is the fighters which were begun after the cessation of hostilities that the Navy is now depending upon. One of these, the F9F *Panther*, served the Navy throughout the Korean War. (*Continued on page* 150)



The Navy's interest in extremely long-range patrol planes led it to sponsor development of the Wright compound engine.

CLEARING

Uncluttered decks of new carrier will take bombers three times as big as 17-ton carrier-based AJ-1

On the carrier USS FRANKLIN D. ROOSEVELT, members of the flight deck control work out a new plan at spotting board.

THE NUMBER ONE offensive weapon of the U.S. Navy is the aircraft carrier. It will probably remain so for years to come. No living thing on God's earth is static—everything grows and goes forward—or it dies. An aircraft carrier is a thing alive. It is a weapon of war: men and planes are a part of her.

Men are born, develop to their prime, then grow old and die. Planes, too, have developed and grown since the first flight at Kittyhawk and are still growing. So it is with the aircraft carrier. Someday, like men, it too may die, but right now and in the forseeable future it is in its youth—the development and growing stage!

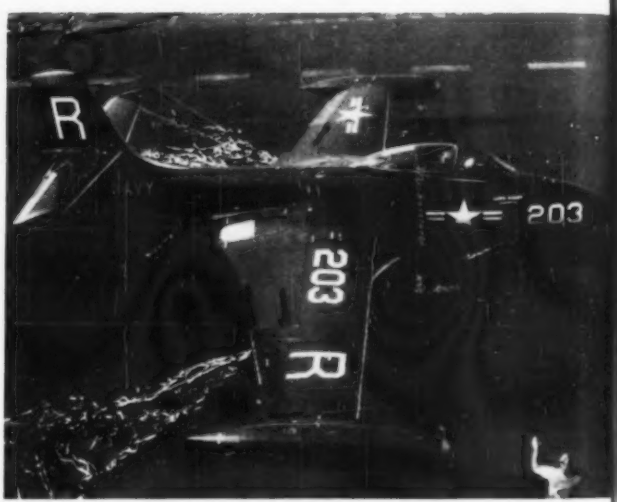
Two years ago some thought that the carrier was dead, but lessons learned in the Korean war, along with other late developments in modern warfare, have proved that nothing could be further from the truth.

The war experiences in 1950 and 1951 shattered ideas that the aircraft carrier is obsolete. Land bases for the air defense of Europe, or elsewhere, are difficult to obtain. And even when obtained, require hundreds of ships and thousands of men for their support and operation. An aircraft carrier is a self-contained mobile airfield which can roam and strike at will anywhere over seven-tenths of the earth's surface—the seven seas. With modern aircraft, there are few military targets in the world out of reach of carrier-based bombers.

As warplane design progresses in range, speed and payload, usually size and weight increases as well. As planes get larger so must the aircraft carrier that handles them. But for the past ten years, Navy plane design was limited by the size of its carriers. The carriers were on hand, so planes had to be designed to fit—a partial stalemate was reached.

The answer was a new carrier built to take care of the latest planes with more range, speed, payload and size.

Construction has started on this new weapon. The largest carriers today are the 45,000 ton MIDWAY class with a 968 ft. flight deck. The new one will be 1,040 ft. long displacing about 60,000 tons. Those may be meaningless sta-



An F2H-2 crashes into the specially-designed jet barriers after missing the arresting gear in a landing on the USS CORAL SEA.

tistics to you, but look at it this way. The MIDWAY class can take care of the AJ-1 attack bomber, which itself weights over 17 tons, has three engines and can carry a much heavier bomb load than other carrier types. The new carrier will be able to carry planes up to the weight of a modern four engine bomber—about three times the size of the AJ-1.

Size alone is not the only factor required in the development of a new carrier. Heavier planes require stronger flight decks and stronger catapults. The new carrier will have them. Also, instead of the usual two catapults, it will have four, making launching twice as fast as previously possible.

Another outstanding feature of the new ship is an elevator island. The entire navigation bridge and flight control structure can be lowered below the level of the flight deck to allow planes with wide wing spans to make unobstructed take-offs or landings.

Four or five elevators will be available to take planes

THE DECK

Aerial view of the USS ORISKANY (CV-34) shows how the carrier looks with a new island and outside elevators installed.

below decks as compared with the MIDWAY's three. Overhead clearance on the hanger deck will be greater to accommodate the higher tails and folded wings of new planes still on the drawing boards or already in the experimental stage.

The new carrier will be quite a weapon indeed!

The Navy's Bureau of Ships (BuShips) and the Bureau of Aeronautics (BuAer) have teamed up to get the new carrier into the fleet by 1955. Special aeronautical features, such as the catapults, are proceeding under the direction of Capt. Sheldon W. Brown, USN, of BuAer and the actual carrier design is the responsibility of Capt. Armand M. Morgan, USN, of BuShips.

Although the development of the new carrier is perhaps the most important step forward in sea-air warfare, the Navy does have many of the World War II ESSEX class carriers on hand. They too are being modernized within the limits of their size.

The familiar outlines of the present day flattops should not lead one to the conclusion that these vessels are identical to those used in World War II. Their profiles may be generally the same, but many important changes have taken place in their equipment for handling and servicing aircraft which are not apparent to the casual observer. These changes too, have been necessary to adapt the carriers to the younger generation of planes inhabiting them.

A careful observer will note that even the profile of some of the ESSEX class have changed. One glance at the modernized version of these ships shows a new island or superstructure. Not so apparent are the strengthened flight decks, larger elevators, higher capacity catapults, greater gasoline storage capacity and many other features which enable them to operate planes of increased performance and striking power.

Provisions have been made for increasing the speed of fueling and defueling aircraft which reduces the "turn around time" between strikes and gets them out faster. Electrical outlets for starting jets and additional facilities for servicing and testing new aircraft electronics equipment have been installed. Alternating as well as direct current electrical power has been added to meet new requirements.

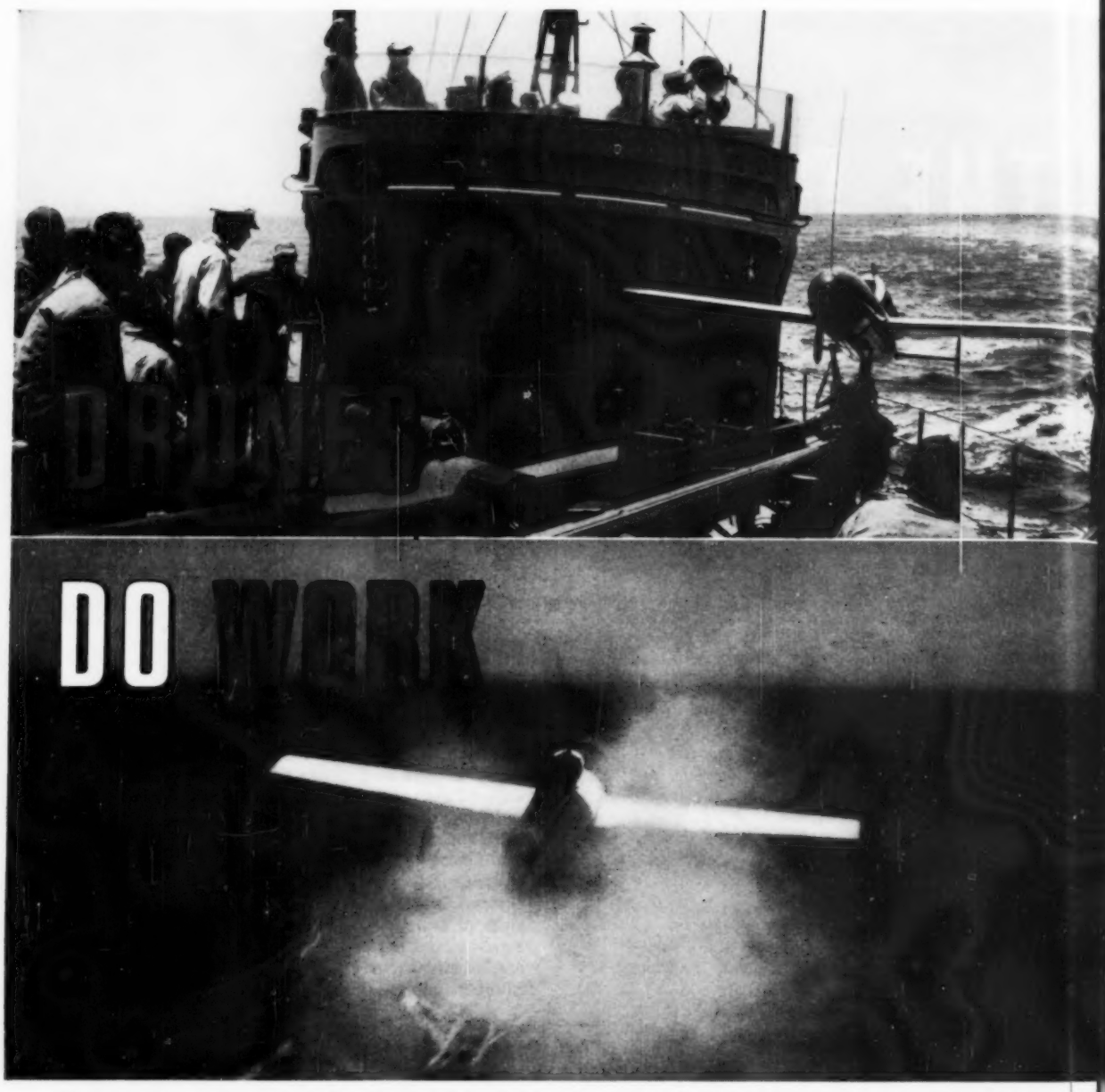
It has been attempted to include every practicable device on these ships to simplify and expedite aircraft operation. Larger and better equipped workshops, fire fighting and aircraft control facilities are an indication of their extent. To get pilots to their planes with the minimum of exertion, even escalators connecting readyrooms and flight decks have been installed.

Perhaps the most important change of all in the modernized ESSEXs is their new catapults which are about twice the capacity of the ones they replaced. Without the new catapults, take-offs of modern jets from the limited confines of a carrier's deck would almost be impossible. Much of the credit for its advanced improvement goes to Mr. J. L. Bachman, Mr. H. S. Hinchman and Comdr. W. H. Ford, USN, of the Naval Aircraft Factory and Mr. F. B. Gross and Mr. J. E. Scholl of BuAer.

Like the ships themselves arresting gear and barriers have made many changes since the days of the Navy's first aircraft carrier LANGLEY. As one might expect, tricycle jet planes require their own specialized equipment in this field too. The fast landing jets stimulated improvements in the arresting gear in the form of larger capacity equipment, improved control valves and longer run-outs. All of these were needed to absorb the violence of jet landings with safety.

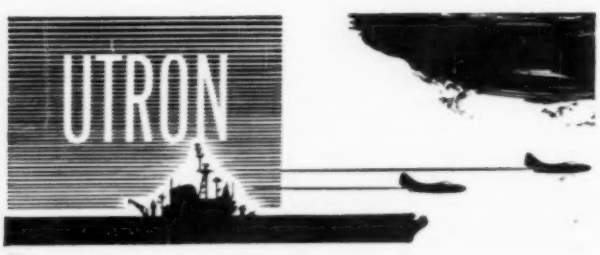
Just in case a landing plane fails to engage an arresting wire when coming aboard a carrier, barriers are installed. A barrier is exactly what its name implies; something for the fouled plane to bump into before it hits parked aircraft forward on the flight deck. Usually the barrier is simply a fence made of heavy steel cables which can be raised and lowered ahead of the landing area of the flight deck, but new tricycle geared planes require their own tailor made fence.

The old barriers have been modified by a fabric adapter, known as the "Davis Barrier" after its designer, Mr. S. V. Davis of the Naval Aircraft Factory. The new barrier works like this. The (*Continued on page* 156)



How a Navy target drone looks as the catapult slams it off the deck of a KD boat during gunnery exercises at sea. Above, the pulse jet drone ready for launching with radio men on the bridge awaiting the signal from the firing ship to release next target.

Here's how Utility Squadrons improve Navy air and ship gunnery.



THE BEST THING to do when attacked by an enemy airplane is to shoot it down. To be able to do this takes more skill than shooting fish in a barrel. A Navy gunner aboard a carrier finds that the ship is moving, the deck is swaying, the airplane he's shooting at is zigging or zagging and there isn't much time in which to get all lined up to pop him. Or a Marine jet pilot, going too fast to hear his guns go off, must nevertheless aim, fire and hit in a fraction of a second.

This kind of shooting takes practice and practice means having a target to shoot at. That's where the Navy's flying Utility Squadrons come in, among other places. The Utrons serve up to ship or plane gunners an amazing variety of targets, most of which do amazing things while getting shot at.

The simplest of the Utrons' targets is the towed sleeve

which looks very much like the windsock at the airport. Taken aloft in the tow plane, the sleeve is streamed behind it by a wire cable. For air to air shooting the target is towed at around 1,500 feet behind. For ground to air firing 7,000 feet of wire is unreeled before the shooting starts.

A Navy jet fighter will average about 15 hits out of 400 tries on a towed sleeve. To a squirrel hunter or bench rest expert this score may seem on the low side. However, it isn't such a bad showing when you remember that it was done by a man moving 500 mph, maybe straight down, who not only had to fire his guns but fly an airplane and do it while surrounded by other airplanes. And his target—just a piece of cloth 20 feet long—was zipping along at 200 m.p.h. and was in range for two seconds.

Of course this is the average. Many do better and some do as badly as the gunner who missed the sleeve but barely missed the tow plane. The pilot of the tow remarked by radio to the pilot of the jet, "May I point out that I'm *pulling* your target, not *pushing* it?"

To add realism the Utrons also tow gliders—13 foot long targets with a wing span of 16 feet. If these survive the fracas, they are brought back to the field by the tow plane which gets in the groove and lands the glider which is automatically detached when it touches down.

The Navy and Marine Corps utility boys have an idea that nothing looks as much like an airplane as an airplane. Since they want target practice to be as much like the chips-down thing as possible, they have progressed a long way from the towed sleeve. Oddly enough, Reginald Denny, the movie star, had a lot to do with this progress toward realism. Back in 1937, he made radio-controlled drones for the Navy's guns to shoot at. Since then more than 13,000 drones have been made and the price today is around $3,500 each. These little 11 foot wingspan jobs can be launched from the ground, ships, or planes. With pulse-jet engines they can do around 200 m.p.h. and can cut any capers a piloted fighter plane can. The drone can be controlled from the ship shooting at it, from a plane, or from the ground. In case it is still operating when the firing stops, the controller can release a 32 foot parachute which lets the drone safely down. At sea small boats make every effort to catch the 'chuting drone before it lands in the water, but even if they miss, the drone has flotation chambers to keep it from sinking.

These drones come close to realism but not close enough for Utility. (There is a rumor in the Navy that Utility will not be satisfied until their targets shoot back at the gunners.) By salvaging old World War II *Hellcats* just before they reached the junk heap, Utron converted them into a superduper drone. Equipped with electronic controls which do everything but start the engine, these target planes can take off, make dive bombing, torpedo or strafing runs, and land untouched by human hands.

The maneuverability of these *Hellcat* drones is probably well illustrated by an occasion when a carrier's gunners seemed unable to get on the target. The chase pilot put the drone through slower and slower runs, shallower dives, and, finally, simple straight and level flights. Result: no hits. "Cease fire," radioed the chase pilot. "Clear the flight deck. I will land the drone aboard and you can beat it to death with swabs."

The drone's take-off and landing are managed from the ground, but as soon as the ground station gets the wheels and flaps up and the engine throttled back, he turns the plane over to the "chase" pilot in flight. The chase pilot, with a miniature stick and rudder buttons, puts the drone through its paces while he stays well out of range of flying ordnance. These F6F's give the gunners everything except the hot wink of wing guns as they dive and strafe. In case a drone's radio brain gets combat fatigue or otherwise won't cooperate with the chase pilot, it is shot down.

Sleeve towing and drone flying are only part of the work Utron does to improve Navy marksmanship. Utron planes photograph hits and misses for torpedo and bombing runs (and in case a torpedo misses, Utron chases the wake and X marks the spot). Utron pilots also spend a lot of time hovering over targets towed by ship photographing surface gunnery, or air to sea shooting. They also spot for ship to shore bombardment.

Utility doesn't get much publicity but it gets a lot of affection from the rest of the Navy. For Utility the Navy and all the brains at Grumman developed the remarkable UF-1. The requirements for this airplane were so varied that it started a rumor that the Navy wanted Grumman to build a contraption that would fly, sail, operate underwater and, possibly, pull a trailer down US No. 1 from Maine to Florida. Actually the Navy requirements fell a little short of such performance. All the Navy wanted for Utron's new airplane was: long (*Continued on page* 170)

A KD boat prepares to take aboard a downed drone, which carries a 32-foot parachute released by a control operator. This KDN-1 drone (below, right) is controlled in flight by radio impulses, and has a top speed of 400 m.p.h., using a 9½-inch turbojet.

'Copters don't want to behave but the Navy has broken them for rescue work, anti-sub spotting and troop carrying

TAMING

IMPROVEMENT OF THE WHIRLY-BIRD has been almost as rapid as the new uses to which 'copters can be put. However, there are several problems which remain to be licked before the helicopter can really do what it is, theoretically, capable of doing.

One of these problems is the lack of inherent stability of a 'copter. Unlike an ordinary airplane, the helicopter doesn't want to behave. This attitude makes a 'copter pilot a very busy boy. Handling the collective pitch—up and down—stick, and the throttle, with his left hand and the cyclic—or where-am-I?—stick with his right, he also has conventional rudder pedals for his feet. Since flying a helicopter makes you feel like you're trying to stay balanced on top of an invisible ball, no pilot with an eye on the future dopes off in these machines. There is no trimming up and sitting back with your feet on the instrument panel in a 'copter—you're flying the thing *all* the time.

Navy sponsoring has already developed a successful "Look Ma, no hands!" gadget which, although still experimental, has flown a 'copter for a short time while the pilot kept his hands in his pockets.

To the fixed-wing men this is just the toddling of a baby, but the whole field of rotary-wing aircraft is still in its infancy. However, because of the huge range of experiments in the fixed-wing field, improvement in helicopters will be far more rapid than, say, the step from the "Spirit of St. Louis" to the *Panther* jet.

The helicopter's ability to fly low and slow or—hover in space—is a most valuable characteristic complete with half a dozen built-in headaches. When the helicopter begins to hover the pilot's troubles start. For instance, ordinary air speed indicators go haywire below about 40 knots. In the first place a hovering 'copter doesn't create enough impact pressure to knock your hat off. In the second, the 'copter slips and slides around without regard to the movement of the immediate air mass. In order to give the pilot some idea about what he's doing, the Navy is now developing an air speed indicator which uses a rotating pressure pick-up system. This device collects and then beefs up what air pressure the 'copter creates and resolves it into an airspeed reading which varies only a knot or so from true.

The attitude of the fuselage of a fixed-wing plane more or less establishes the condition of flight. The reverse is true of the helicopter—the attitude of the fuselage follows the condition of flight. Working always toward hands-off flight under instrument conditions, the Navy has awarded to Bell a contract to produce a rotor attitude indicator. Such an indicator would allow a pilot to hover at zero groundspeed even under instrument conditions and still have some idea where he was.

Navigating a helicopter is hard. It is so hard, in fact, that many pilots have reverted to the old twin-beam or follow the railroad track system. (Using this system brings out another peculiarity of the 'copter—slow freights pass them by). However, the day is not far off when a heli-

copter can be navigated as easily as any other type of plane.

Present day helicopters are limited in speed by the annoying fact that the rotor blade moving into the relative wind meets more resistance than the blade moving out of it. Beyond a certain speed the going out blade stalls. This doesn't produce the sickening effect of a stall in a fixed wing craft, but it sets up a vibration that is hard on bridgework. This stalling out can be prevented to a certain extent by increasing the angle of attack of the going out blade but there is a mechanical limit to how fast this can be done.

To get around this problem the Navy is experimenting with a wedding of the fixed with the rotary wing. For cruising, the fixed wing and conventional prop would sustain the contraption—the rotary wing taking over for up, down and hovering maneuvers.

Production of helicopter transmissions is a bottleneck at present and, to break it, the Navy and McCulloch Motors are testing belt driven transmissions in the MC-4 tandem 'copters. The Navy is also testing a "fluid drive" transmission. This is being worked out in a Kaman *K-190* into which one of Boeing's little 502 turbines is being installed. The main purpose of this experiment is to study the control rate between power and rotor—in other words, how much lag there is between the time power is applied or taken off and the rotor blades speed up or slow down.

The Navy has always been disturbed by the amount of power it takes to turn a prop blade by pushing on the hub. With ship and conventional airplane propellers there seems to be no other way to do it, but the helicopter blades offer great possibilities of an entirely different type of propulsion.

Since the Navy has a vast amount of information about rocket and ram-jet engines gathered in its other experiments, it is applying some of it to the problem of helicopters.

The Navy argues that if you can make the 'copter blades go around by pushing the tips instead of turning the hub, you not only save a lot of power, but you also by-pass the always bothersome problem of a transmission.

Navy thinking on jet propulsion of helicopters is running in two lines. One is to mount the entire engine, fuel and all—rocket or ram-jet—on the tip of each rotor. Of course, this makes problems spring up all over the place. One of them is: how can the pilot stop the thing once it gets started? Perhaps, thinks the Navy, controls can be run up through the hub, out through the blade and to the engine. Even if this can be successfully done, the problem of a blade big enough and strong enough to whirl around carrying its own fuel looms a little bigger than life size.

Sticking to the principle of pushing the tip with jet power, the Navy is working on an entirely different way of handling the fuel. If only the get-up-and-go part of a jet engine is mounted on the (*Continued on page* 146)

THE WHIRLY-BIRD

Marine pilot goes over check-off sheet of HTL-4 type helicopter before starting engine for ascent from air station at Quantico.

Helicopters have proven to be effective troop carriers in Korea. Here Navy 'copters are land fighting Marines behind lines.

HE GREW WITH IT

Pat Byrne's 20,000 pilot hours and more than 30-year service prove the Navy offers a good career.

THIRTY-FOUR YEARS and 20,000 pilot hours ago, Chief Boatswain Patrick J. Byrne, USN, was an aviation mech figuring out the wires, nuts, bolts and sticks of the World War I "F-boat" seaplanes at Pensacola. Thirty-four years is a big hunk of any man's life, and 20,000 pilot hours is about equal to seven and a half round trips to the moon, but today he's still married to the sweetheart of his youth—Navy seaplanes.

Pat wasn't through the gates of Pensacola long in 1917 before he decided that gold wings and the life of a pilot were for him. So he found a spot for himself in the first enlisted men's flight training class and pinned on Naval Aviation Pilot wings number 10 in 1920. Since then he's seen Naval Aviation grow from 1920's less than 1,000 to World War II's 41,000 planes, and has gone up through the ranks from aviation mech to lieutenant commander and back again to his permanent warrant rank of chief boatswain. The latter event happened when they tried to retire him after 30 years of service during the economy wave of early 1950.

Pat's 55 years old now, and under pressure will admit that his eyes aren't what they used to be. But he's still a very active pilot ferrying seaplanes with VR-31 between Norfolk and Seattle. Pat claims his success is due to drinking only "white bourbon" straight from the cow.

The big "boats" stick to the coastal route during ferrying, cruising from Norfolk to Seattle via Jacksonville, Pensacola, Corpus Christi, San Diego and Alameda. Pat never bothers with maps on this route. While cruising along the coastline he will sit back and brief a young and inexperienced co-pilot on the check points coming up, calling off the towns, inlets, and lighthouses by their name and in the order they'll appear. He even tunes the range receiver to the proper frequencies of the various radio stations across the country. Occasionally though, he will forget the frequency of a particular range and will ask the co-pilot to look it up on the airways chart, explaining with a grin, "My eyes aren't what they used to be, mate."

In Naval Aviation circles that expression, "mate," is a trademark of Pat Byrne. Some say he walks down the halls of the Pentagon calling admirals "mate" or else by their first name. Whether this is true or not, the fact remains that Pat was a flight instructor at Pensacola when many of today's admirals went through flight training.

Pat Byrne was a carrier pilot in 1925 aboard the Navy's first flattop, the U.S.S. *Langley*, but he is one of "the experts" in seaplanes and flying boats. During the last war, as a lieutenant commander, Pat pioneered and surveyed many of the world-wide overwater routes of the Naval Air Transport Service. He taught hundreds of young pilots flying boat operations too, for that command.

When the Navy's largest flying boat, the JRM *Mars*, was being developed the Navy pilot who naturally got the nod to help with the project was Pat Byrne. He worked with the *Mars* for thirteen months, and during the slack periods took time off to train more youngsters in "big boats."

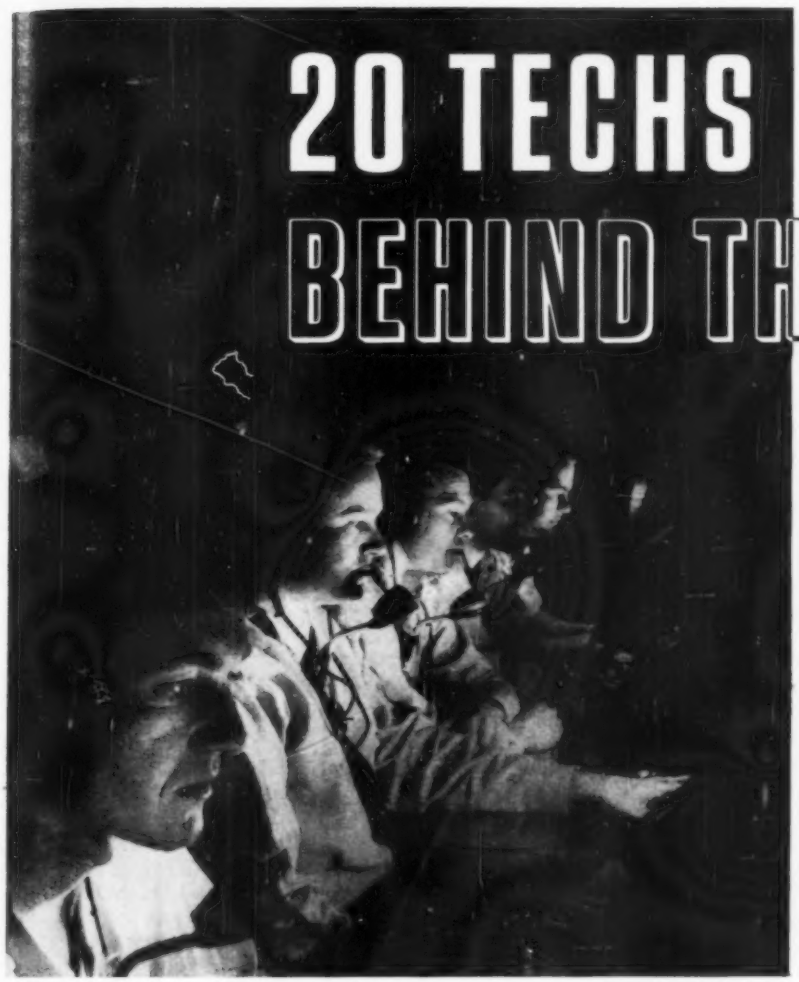
Pat has used more than 90 different types of aircraft in racking up his 20,000-plus hours of flight time. He doesn't fly fighters much any more, but there's a story circulating around the Navy about Pat's much-kidded-about, aging eye-sight and the F8F *Bearcat* fighter.

Even in this modern age of jets, the prop-driven F8F is still a hot little fighter for pilots much younger than Pat Byrne. When the Bearcats first started rolling off the assembly lines Pat was in one of the squadrons ferrying them. Almost every pilot in the outfit except Pat had flown them—he was sticking to his "boats." The razzing he was getting about being too old to fly such a hot fighter finally got under his skin, so Pat quietly went out on the line and picked out a good looking *Bearcat* to strap on for size.

The take off and flight were presumed to be uneventful, but when he came roaring over the field and dropped his gear for landing the loudspeakers in the control tower crackled with a high pitched voice shouting, "OK, mate. Just tell me when I'm about 50 feet off the deck and I think I can ease her down OK!"

Like any other one spot on the globe, Pat spends very little time in his home port with his wife and daughter in Rumson.

20 TECHS BEHIND THE PILOT



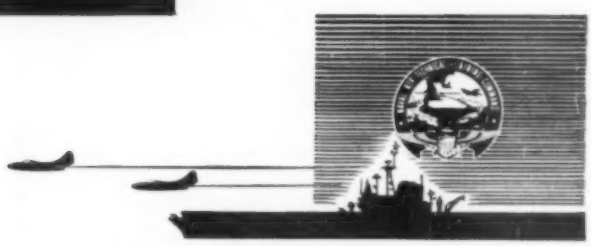
Navy trains more Air technicians than there are students at Yale, MIT and Georgia Tech.

A HOUSEWIFE'S CHORES are never done; neither are those of the Naval Air Technical Training Command. Every Navy plane in the air from Corn Center, Iowa, to Bab el Mandeb in the Gulf of Aden requires 15 to 20 skilled technicians to keep it flying. That's a large order. To meet it Tech Training turns out more trained aviation personnel annually than there are students graduated each June from Massachusetts Institute of Technology, Georgia Tech and Yale combined!

Chief of Naval Air Technical Training is Rear Adm. W. D. Johnson, USN. Under his command are more than 30 aviation technical schools. To bring home the kind of function these schools perform let's take two recent graduates more or less at random. Meet Dave Aitken of Euclid, Ohio, and Wally Sharp of Los Animas, Colo. Airman Dave, with only eight months in the Navy, graduated as a trained aircraft mechanic. Lieut. (jg) Wally, with more than eight years of service, left the Tech Training Command armed with the "know how" to successfully run an aviation electronics shop.

Let's go back to school with Dave and Wally and see what it takes to train the technicians of Naval Aviation.

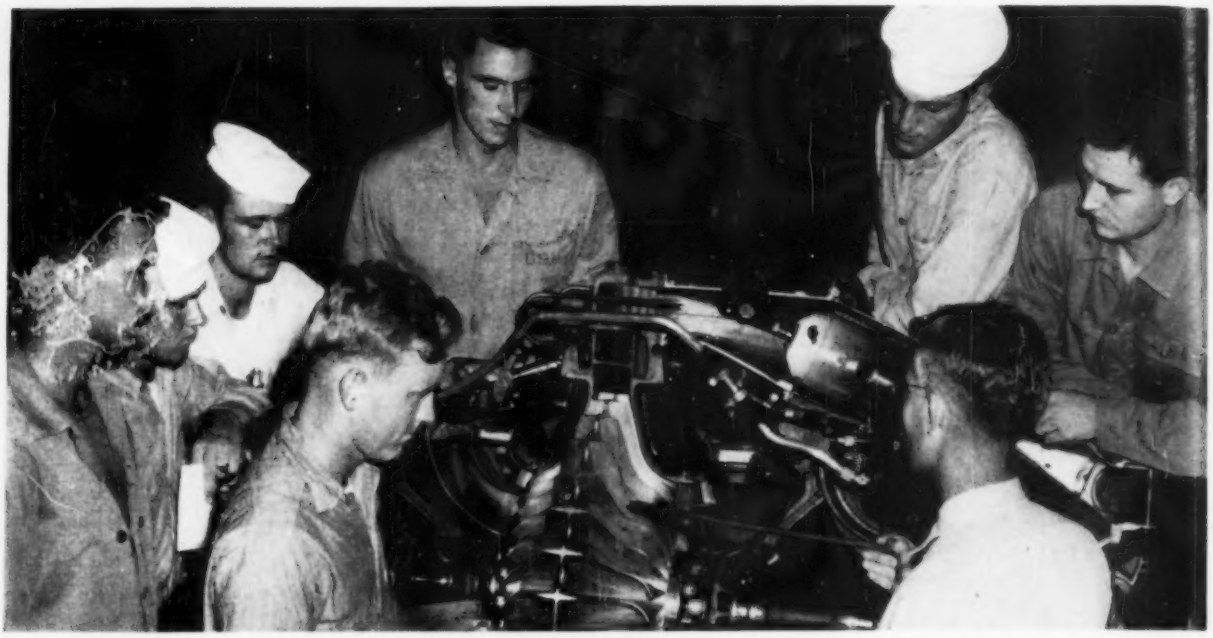
After his boot training, Airman Apprentice David A. Aitken, USN, was sent to NATTC (Naval Air Technical Training Center) Jacksonville, Fla. Thus he began his



life of working, eating and sleeping aviation. He got a thorough indoctrination in aviation history, plane types, safety precautions, taxi signals, carrier flight deck operations, cockpit familiarization, engine starting and thousands of other facets on Naval aircraft operation. He learned how to use and inspect all the survival and emergency equipment used by pilots, air and ground crews. Dave even had to whip mathematics, blueprint reading and layout, physics, handtools, interphone procedures and aircraft gunnery.

At Jacksonville, he was also instructed in each of the 13 Navy aviation rating structures, and actually performed many of the duties of each rate in the various "rate shops." This gave Dave and his mates an understanding of "what the other guy is doing" regardless of whatever his own eventual specialty might be. It also helped Dave make up his own mind on what *he* wanted to do in the Navy.

Dave decided he wanted more training as an airplane mechanic. The Navy thought that this was a good idea too,



Instructor explains jet engine operations to a class at the AD(A) School. He is using a cut-away of the Allison J-33 turbo-jet.

Aviation machinist's mates inspect a gas turbine engine. Upon completion of their training, they are experts on all engines.

both for the Navy's good and for Dave's too. Before he came into Naval Aviation, Dave studied a year and a half of college mechanical engineering in Cleveland. He had the background to make a darn fine mech, so off he went to the 14-week Aviation Machinist's Mate School at NATTC Memphis.

"That school is no snap either," Dave says now. "I don't care how much schooling a guy's had before, he has to study—and how! I really had to buckle down on the homework. Now that I've graduated I can say that I thoroughly enjoyed it. The Navy has given me the opportunity to learn about planes, and what I've learned should be a big help when I go back to college some day.

"After I checked in at Memphis," continued Airman Aitken, "they started me on the basic information relative to an airplane mechanic's work like principles of engine operation, engine parts and nomenclature, power transmission systems, fuel, ignition, lubrication and so on. They told us that this was the basic foundation necessary for understanding complex modern aircraft. I thought at the time, 'They call this basic. Brother, how can it get *more* complicated?' "

Following mastery of basic fundamentals in the school, the student is carried by logical steps and in ever increasing detail through the work done by an aviation mechanic. The Navy's technician is trained in an exceptionally brief period of time. He learns reciprocating, turbo-prop and jet engines, and all aspects of planes and their powerplants. For example, aircraft hardware is important in planes, so he must understand the purpose, application, types, identification and nomenclature of threads, bolts, machine screws, cap screws, studs, nuts, cotter pins, washers and safety wiring used on aircraft.

Students at the Aviation Machinist's Mate School don't absorb all of this information by osmosis—or by classroom work only. They learn by doing. Dave Aitken took an engine apart and put it together again. Working on planes and engines gave him a first-hand knowledge of ignition systems consisting of the magneto, ignition harness, induction vibrator, spark plugs, high tension and low tension ignition. Lubricat- (*Continued on page* 139)

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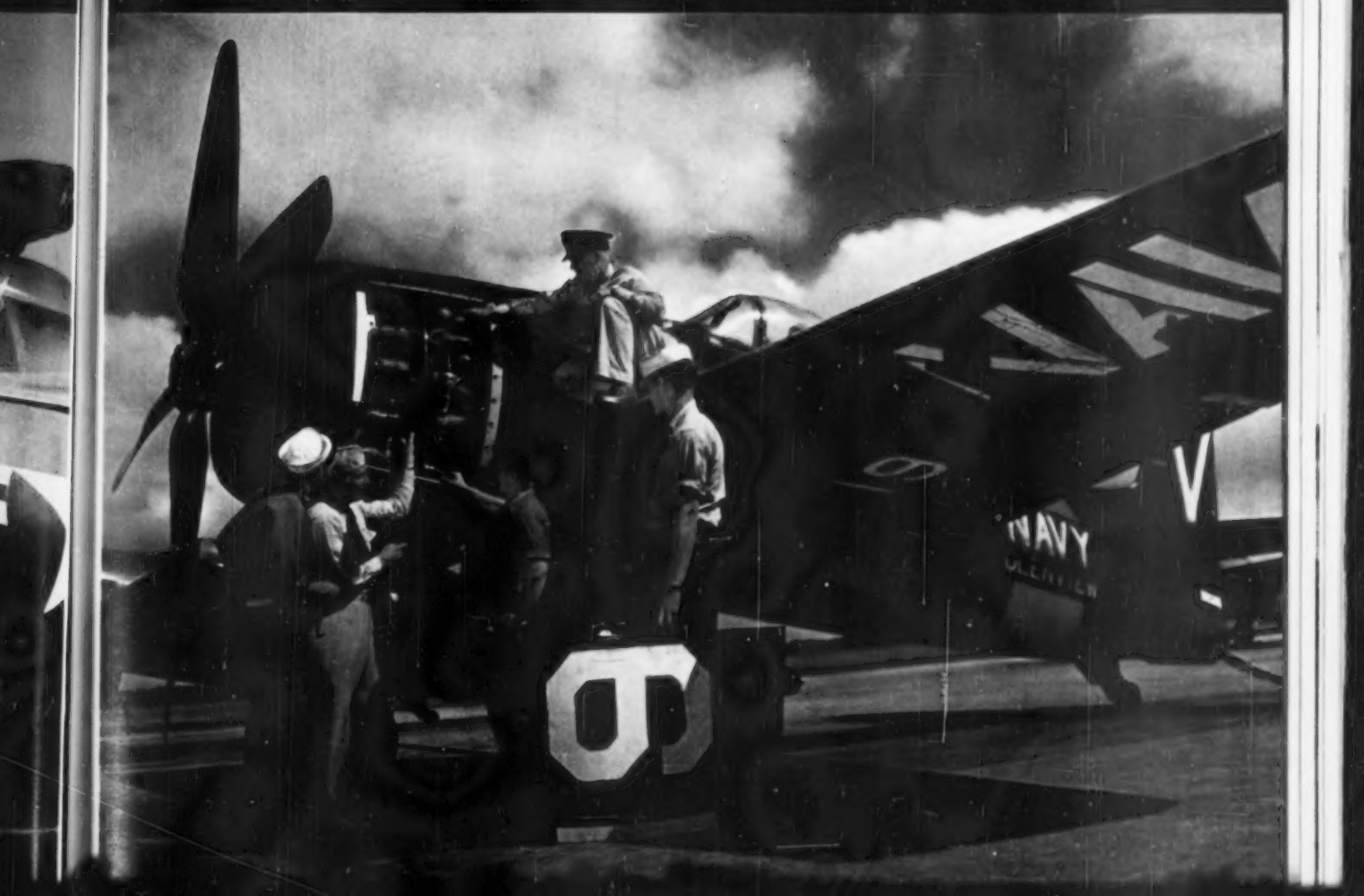
Night Banshee

Gun crew checks ornament of an F2H-N, night fighter version of the Navy's fast Banshee.

The tremendous firepower of Naval aircraft is shown here, as Marine ordnance men attach rockets to F4U wing racks (above) at Cherry Point, and a deck crew aboard a carrier places light bombs in position.

Deadly 5-inch HVAR rockets are being attached to wing rack of the Navy's long-range P2V Neptune. Below, engine check of F8F Bearcat before takeoff on an Air Reserve training mission at Glenview, Ill.



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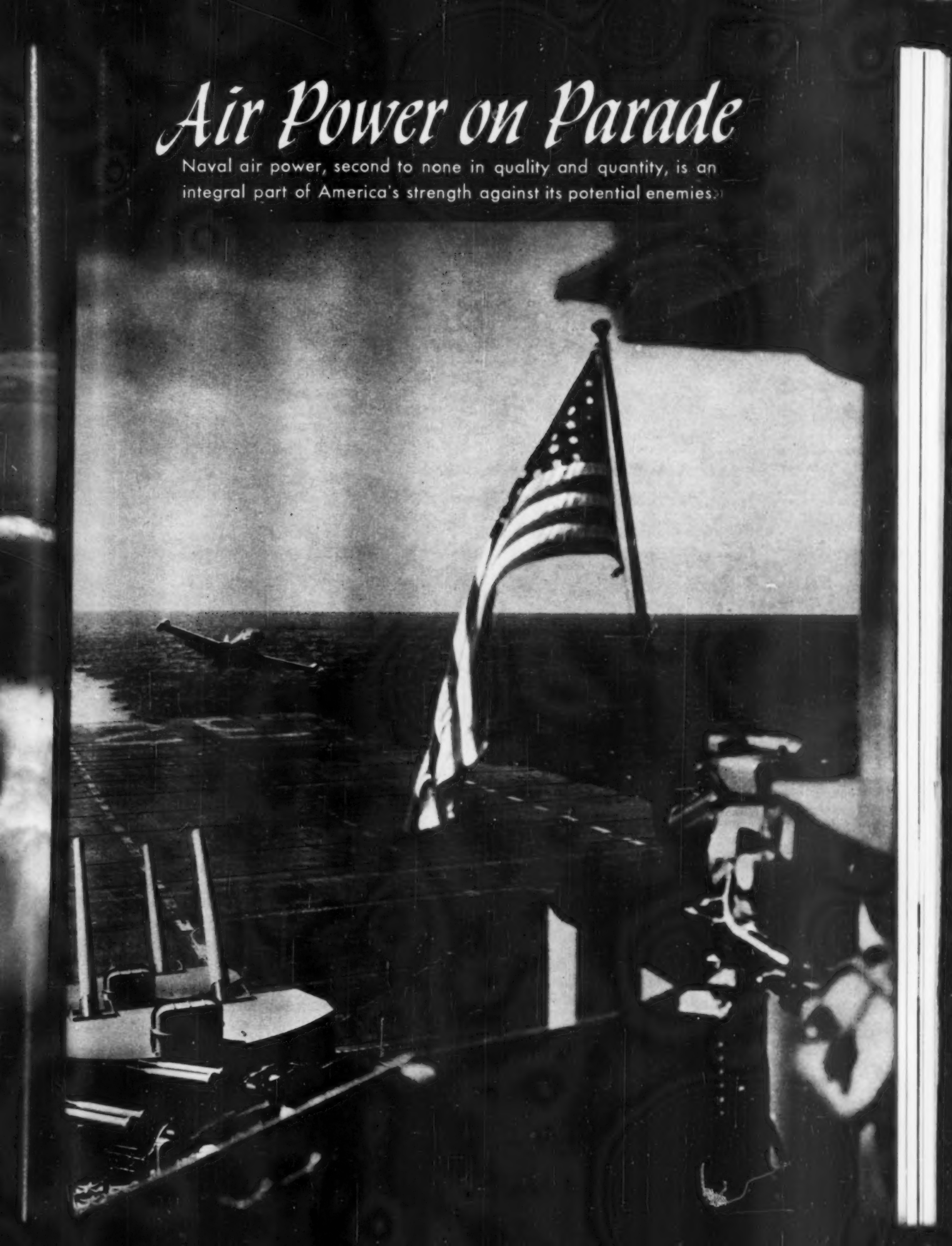
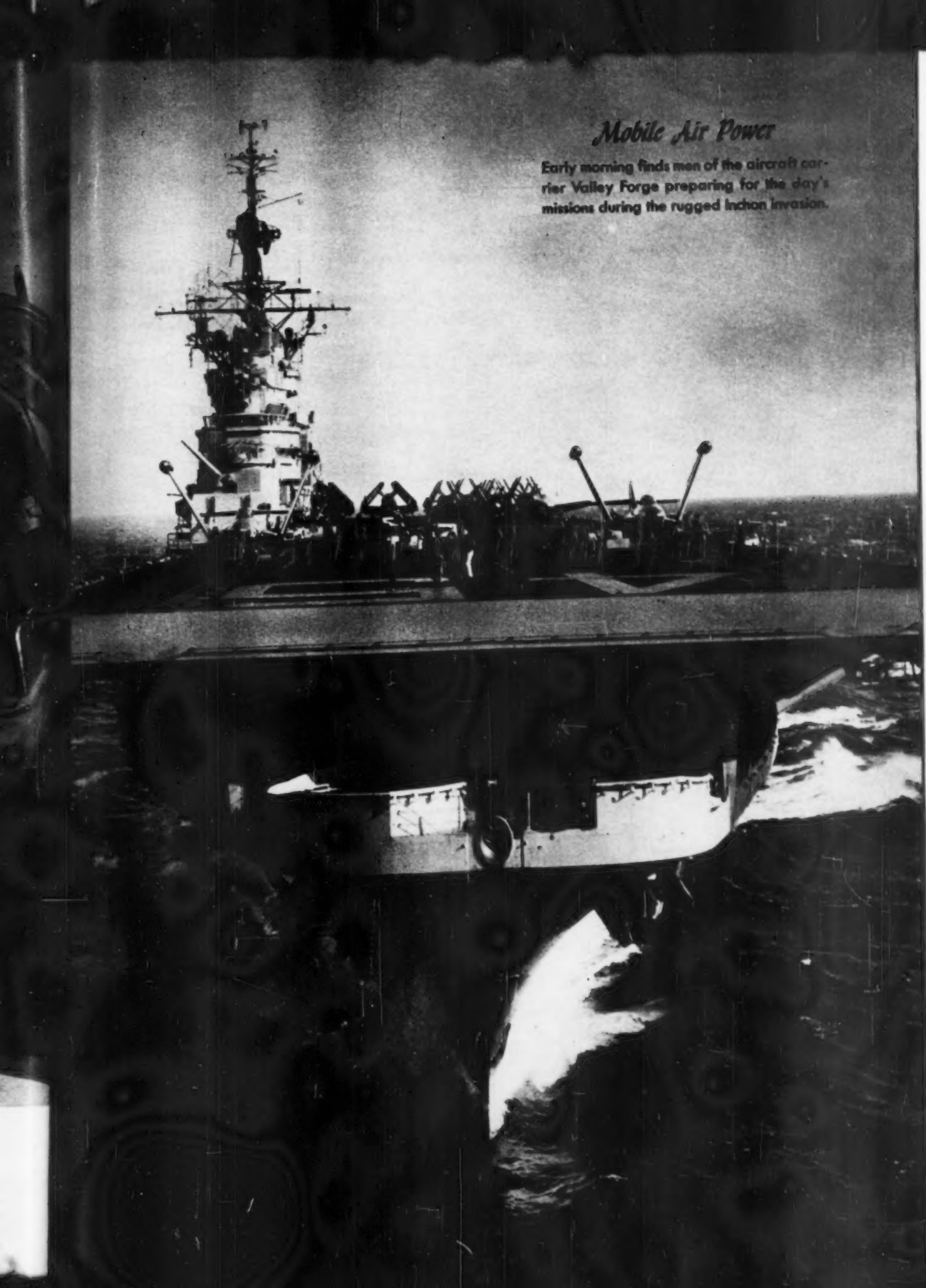
Air Power on Parade

Naval air power, second to none in quality and quantity, is an integral part of America's strength against its potential enemies.



Korea Bound

Fighter pilot, briefed for strike against Chinese Communists' ground installations, awaits takeoff signal aboard Valley Forge.



Mobile Air Power

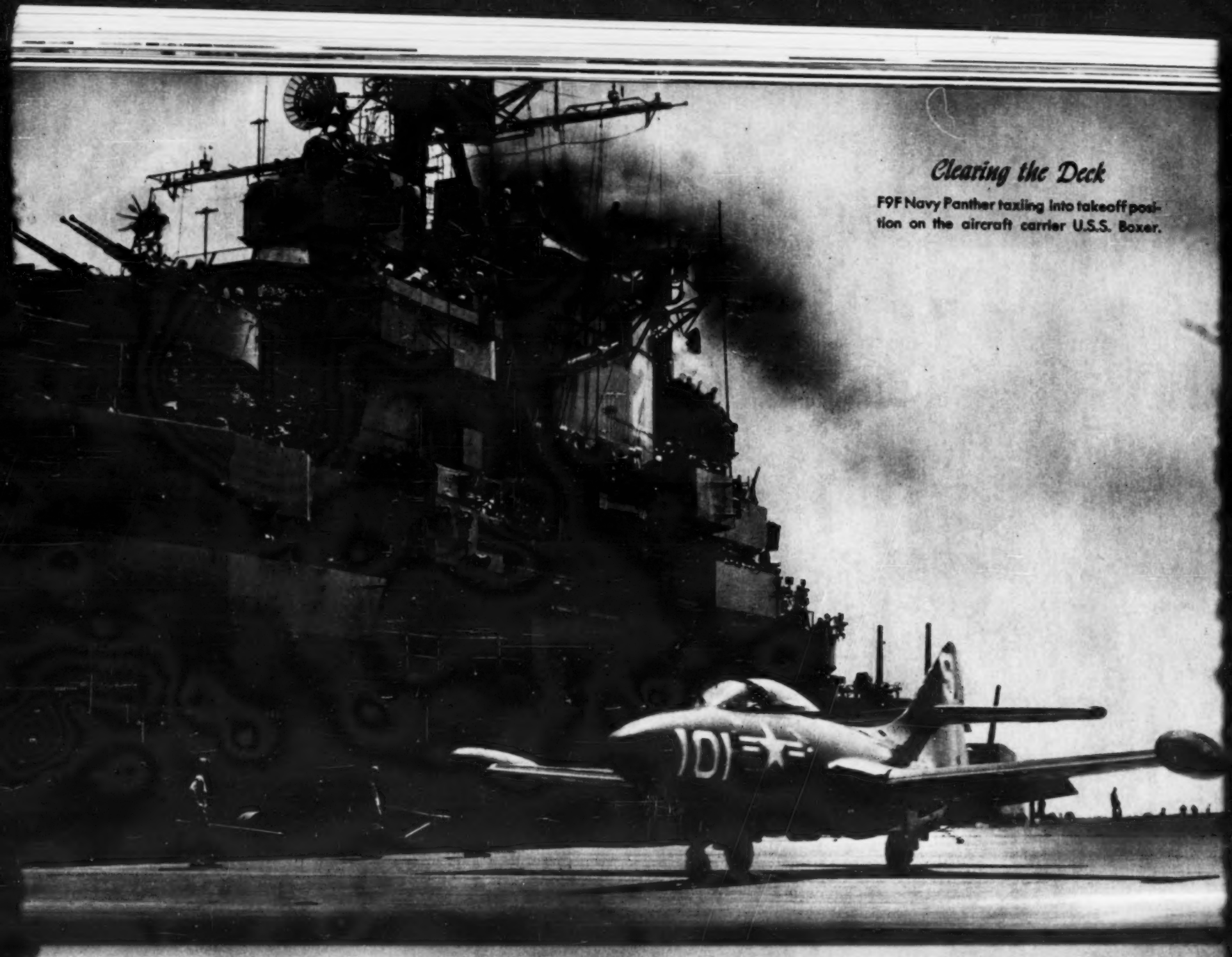
Early morning finds men of the aircraft carrier Valley Forge preparing for the day's missions during the rugged Inchon invasion.

Radar Tracker

Long-range anti-sub patrol planes, such as this PBM, are essential to fleet operations.

Thirsty Panther

Deck crew refilling wing tip fuel tank of one of the Navy's first-line jet fighters.

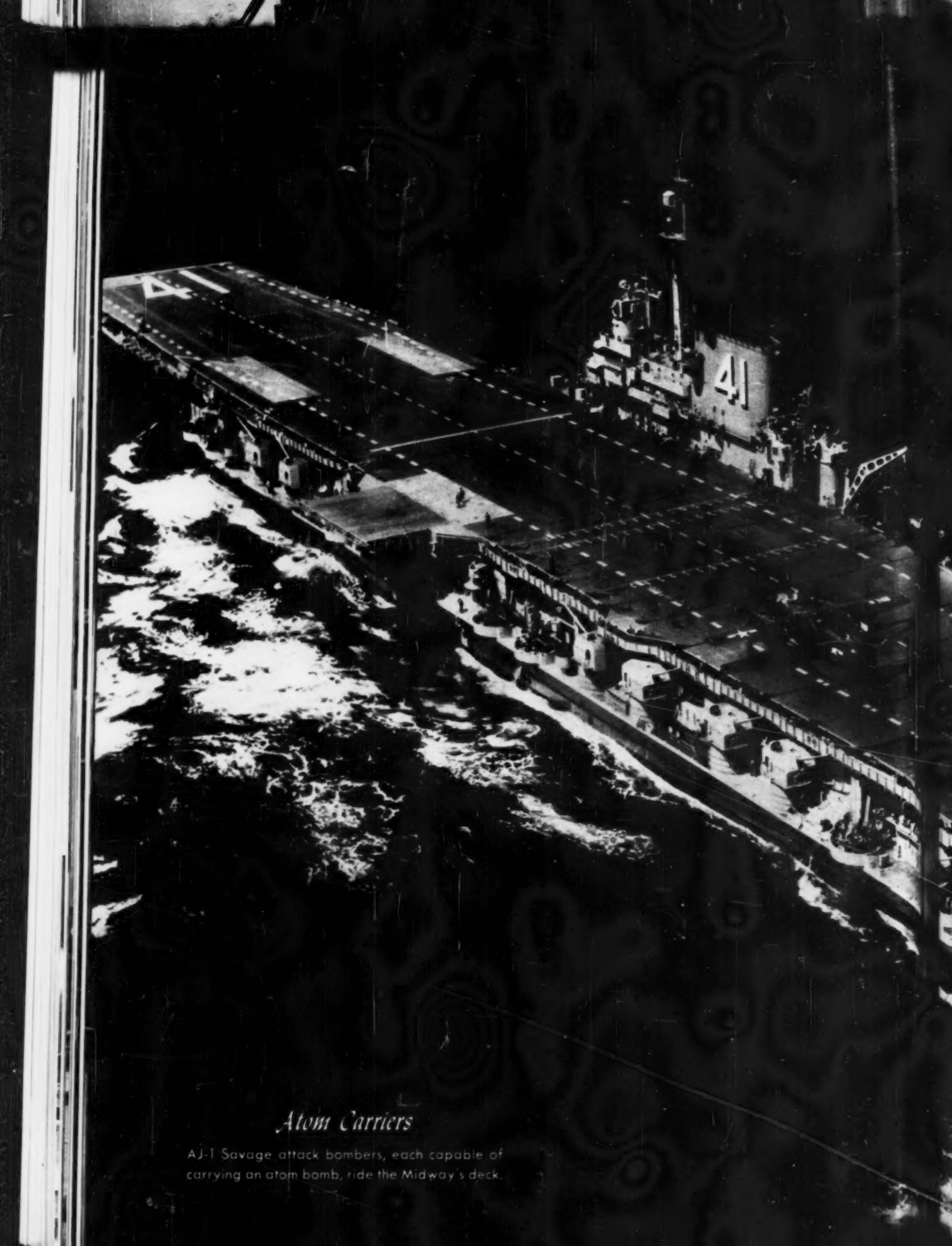


Clearing the Deck

F9F Navy Panther taxiing into takeoff position on the aircraft carrier U.S.S. Boxer.

Ready Raider

Ready For Action—A Skyraider rides the outboard elevator up to flight deck of its carrier.



Atom Carriers

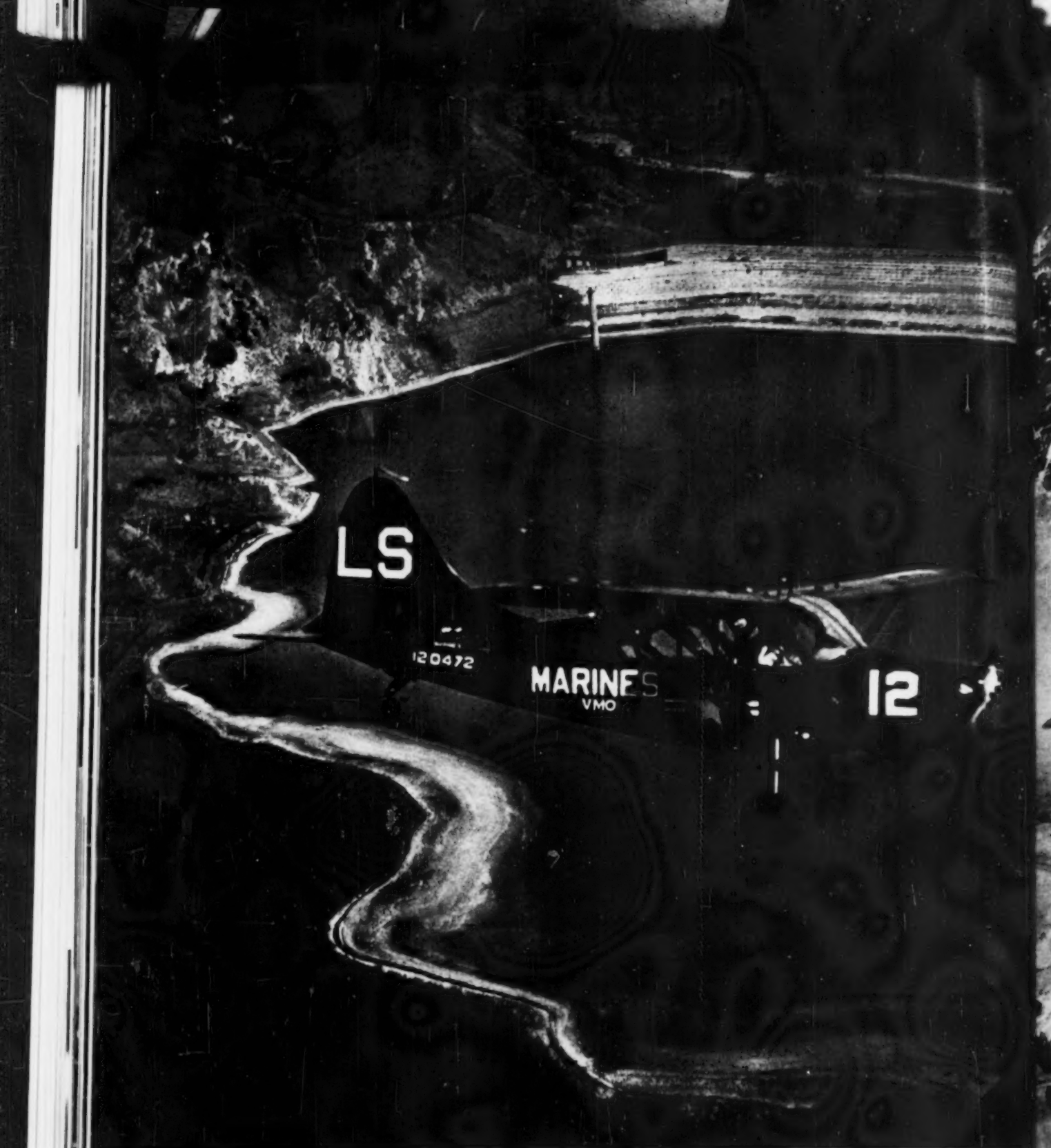
AJ-1 Savage attack bombers, each capable of carrying an atom bomb, ride the Midway's deck.

1000 Pounder

Crew chief and pilot check a bomb's fuse before a fighter plane mission beyond the enemy's lines.

The Final Check

Refueling and rearming an F4U, as the U.S.S. Princeton cruises offshore in Korean waters.



Midget and Giant

It takes all kinds of planes to make an air Navy. Shown are an OY hedge-hopping liaison plane and an ocean-hopping JRM-2 supply-patrol aircraft.

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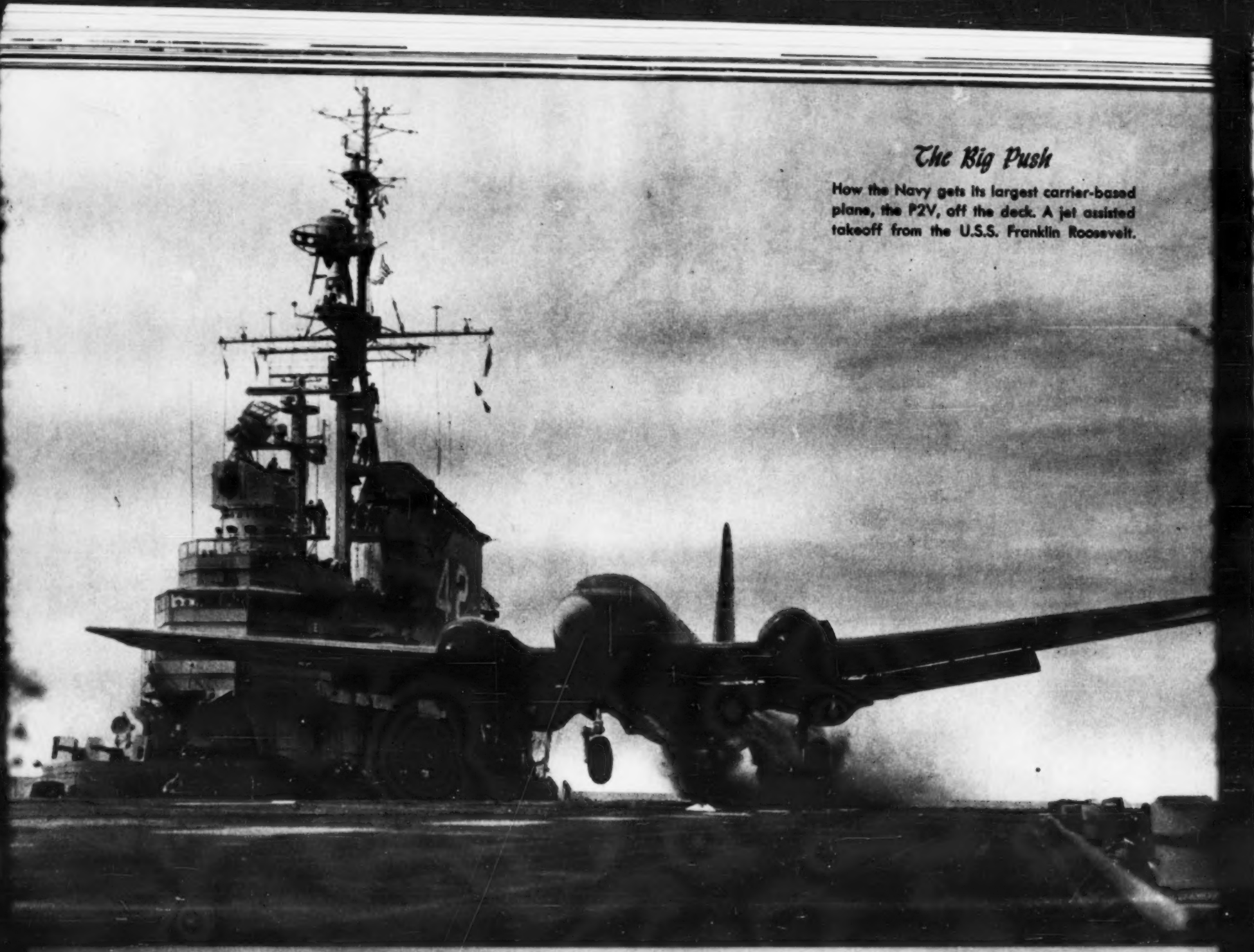


The Big Push

How the Navy gets its largest carrier-based plane, the P2V, off the deck. A jet assisted takeoff from the U.S.S. Franklin Roosevelt.

Hooked

An AJ-1 bomber, with hook engaged, about to settle down on the deck of the U.S.S. Midway after the "cut" signal from landing officer.

Wings of Gold

Proudest moment in a Naval aviator's life—
when his girl pins on his new Wings of Gold.

Naval Air Training Command produces precision flyers, expert navigators, winning fighters *and* Naval officers.

The NavCad's first landing on an aircraft carrier marks his transition from cadet to full-fledged Naval aviator.

TRAINING NAVY PILOTS

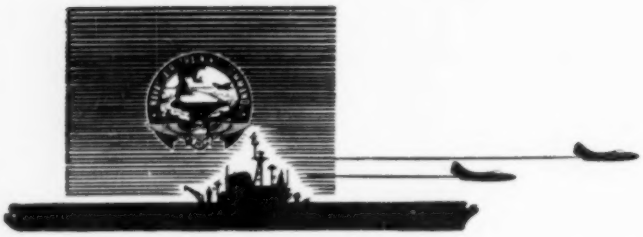
The Cadet's most memorable day comes when he gets the signal from his instructor to "go it alone" for the first time.

ALMOST EVERY American boy can learn to fly an airplane, but not for the Navy or Marine Corps. Rigid physical and mental requirements prevent many from even applying. Of those selected for flight training as Naval aviation cadets approximately 30 per cent will fail to make the grade.

Why are the United States Navy and Marine Corps so insistent upon pinning its gold wings upon only the best? The answer is simple. A Naval aviator must be a master of precision flying. He must fly over endless miles of unmarked ocean where one small miscalculation can cost many lives. In addition, a Naval aviator must be more than a fly-boy. As a commissioned officer of the line, he must assume the responsibilities of his rank, both as an administrator and a leader of men.

Prior to World War II, the training of Naval aviation cadets was done at Pensacola, Fla. Here they learned to fly land and sea planes. In those days the Navy's air arm was small and a pilot was required to take his place in the fleet wherever he was needed most, whether it was on carrier-based dive bombers and fighters, multi-engined sea planes or single-engine float planes that were catapulted from cruisers and battleships. All this has changed, however.

Today Pensacola is the headquarters of the Chief of



Naval Air Basic Training. There the Naval aviation cadet begins the 18 months of intensive instruction that have, for their end result, the coveted golden wings of Naval aviation.

NavCad is the short form for the Naval aviation cadet. He is also referred to, at Pensacola, as an officer candidate. In order to be selected for flight training the applicant must be at least 18 and not more than 26 years of age. He must be single and agree to remain so until he has completed his flight training. Physically he must, in the eyes of the Navy flight surgeon, be just about perfect. To qualify mentally, he must have completed at least two years of college. Applicants are screened and selected at the twenty-eight Naval Reserve air stations in major sections of the United States. Once selected they are put on the waiting list and within 120 days sent to Pensacola.

Enlisted sailors and marines on active duty with the fleet may apply for NavCad training by meeting the same requirements as those set up for civilians with one exception. If they do not have the minimum of two years of college, this can be overcome by outside study and by passing an examination indicating their intelligence level is the equivalent of a two-year college man. A small percentage of each cadet class is made up of fleet personnel.

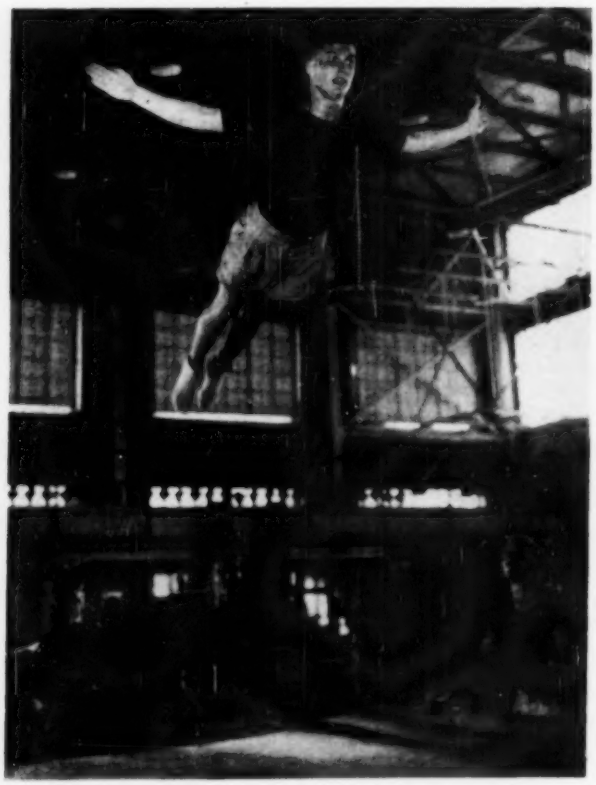
When a new cadet reports in at Pensacola he is immediately ordered to the Naval School of Pre-Flight. He will spend 15 weeks here. He must meet the Air Training Command's hardest tests of intestinal fortitude, physical ability, officer-like qualities and mental capacity in order to qualify for further training.

The NavCad must pass the pre-flight phase before he is permitted to touch the controls of an airplane. Flight training cost a great deal of money and the Navy, striving constantly for economy, evaluates each officer candidate. He must prove first that he is a good risk. If the cadet obviously hasn't got the stuff, then it is best that he is dropped before more government money is spent on him. That is why the attrition rate in pre-flight is greater than in any other phase of training.

The Pre-Flight school, which is divided into three departments—academic, athletic and military—entails 533 hours of instruction. Academically, the course covers such subjects as aerology, engineering, naval orientation, navigation and principles of flight and reading improvement, with particular emphasis placed upon navigation.

It is not the design of the athletic department to make Mister Americas out of NavCads. Rather it strives to give them all a basic knowledge of most team sports along with tumbling, wrestling and boxing. Swimming is important to men who fly over water and each cadet must pass rigid swimming tests. These include successfully riding the "Dilbet Dunker," a synthetic trainer designed to approximate the most feared of all forced landings on the sea—a plane crashing into the water nose down and then flipping over on its back.

The military side of pre-flight is conducted by Marine Corps personnel. They give the NavCad a lasting indoc-



Tumbling goes a long way toward developing the coordination and agility so vital to a pilot's mental and physical keenness.

Every Navy aviator must know the principles of navigation. The pre-flight school stresses the subject over all the others.

trination in military drill, courtesy and bearing. There is no greater example in the world for military men to emulate than the United States Marines and what the NavCad learns from that outfit is priceless.

Each cadet is assigned to a barracks room, which he shares with three classmates. Each has a bed, locker, desk and other fixtures conducive to comfort and study.

Mustered for the first time, the new class, approximately 90 strong, is a nondescript looking group of civilians. Most of them have had no previous military training. The Marines waste no time squaring them away. Rules and regulations must be understood and adhered to. For infractions, demerits are assigned, 2½ of which must be nullified by marching with a gun for one hour on the drill area or "Grinder," as it is best known to Cadets.

Two days are required for the new class to be outfitted and it is a proud group of young men who, on the morning of the third day, muster in front of their barracks dressed in khaki with gold anchors signifying the Naval aviation cadet on their collars. The uniform does something to them.

"All work and no play makes Jack a dull boy," so the saying goes, so, in keeping with the desire for keen minds and high morale among the NavCads, there are many recreational facilities available which they may utilize without even leaving the confines of the Naval Air Station. A brief roundup of these sports includes golf, swimming in the Gulf, sailing, fishing and the ACRAC club. ACRAC stands for Aviation Cadet Recreation Center or club.

The greatest day for a NavCad during his 15 weeks in pre-flight is the one when he receives his graduation certificate and is ordered to report to Whiting Field, Fla., for flight training. During his (*Continued on page* 168)

Students at Corry Field's BTU-2 undergo instrument and night flying preliminaries in the Link trainers before actual flight.

NavCad, using the aviation safety parachute device, learns about proper jumping technique at Whiting Field in Florida.

Fellow-students congratulate cadet on his first solo flight by chasing him and tearing his tie before he buys them beers.

The Air Force and the Navy, playing on the same side, have made MATS a winning team.

NAVY LIFTS ITS SHARE

IN NOVEMBER, 1948, Navy R5D 6265 was in the traffic pattern at Rhein Main AFB in Germany. On downwind, the pilot called in and requested a set of "wheels" stand-by on the ramp. Now a wheel is a wheel, but there was some confusion on definition in the control tower. The Air Force came through in rapid fashion, however, and when 6265 hit the blocks a set of R5D *Skymaster* wheels awaited.

Actually, all the Navy wanted was transportation for an Army colonel who had bummed a ride into Rhein Main from Tempelhof. The colonel looked over his "wheels," rolled up his trousers and waded through the slush to Operations.

That happened during the early days of the Navy on the Berlin airlift. Later on a Navy lieutenant could hold his own in a conversation dealing with such purely Air Force terms as "field grade," the "IG," "AG" and an "MOS." On the other hand, the Air Force began to get used to such nautical terms as "scuttlebutt," "head," "deck" and they even learned the meaning of "wheels." Another thing the Air Force soon became used to, was seeing one or the other of the two Navy squadrons "showing the way" on the air-lift.

Naval Air Transport squadrons' Six and Eight were new members of the embryonic Military Air Transport organization when they joined the Berlin airlift early in November, 1948. The ink was still damp on the Department of Defense directive establishing MATS and decommissioning the Naval Air Transport Service and the Air Transport Command, when the Russians cooked up the Berlin blockade. In the largest air transport operation ever undertaken—the supply of a major metropolis by air—military air transportation won an important campaign in the diplomatic battle between the East and the West. It is worth reviewing.

The contribution of the two 12-plane Navy squadrons

In the early morning cold at Travis field, wounded soldier from Korean battlefield is carried on MATS plane, bound for home.

to this "Vittles" operation for which they received the Medal for Humane Action, can be told with a succinct set of statistics, and with considerable pride. Under the calm leadership of Capt. J. O. Vosseller, VR-8 wound up its Germany tour at the end of the blockade with title of Most Efficient Squadron. The record of VR-6 completed the score for the Navy. When the VR-8 marks were bettered, it was usually due to the efforts of Capt. H. P. Badger ("Orderly, ease back and wake up the passengers, we're on the deck"), and his boys.

Lieutenant Buergy's "Ten Tons to Tempelhof" became the Navy battle-cry and, from November 1, 1948, to August 1, 1949, they flew 55,666 hours. The Navy hauled 157,439 tons of supplies to the beleaguered peoples of Berlin, with an average utilization—Airlift record—for the period of 9.82 hours per plane per day. In April, 1949, the two Navy squadrons averaged a utilization of 12.45 hours

MATS ammunition cargo is unloaded by Korean native soldiers and is rushed to the front to hold the line against North Koreans.

per plane per day for the month—a record. During this same month VR-8 established the monthly utilization mark for any squadron on the lift, 13.5 hours. June was another 12-plus hour utilization month for the Navy.

Squadron Eight held the top overall efficiency record for the entire lift. VR-6 ran a close second. The Navy squadrons held all availability records, with VR-6 keeping an average of 81 per cent availability during the entire lift. The sister unit, VR-8 maintained an average availability of 75 per cent. The Navy squadrons also held the record for heaviest average load for C-54/R5D types carried between Rhein Main and Berlin during Vittles with a mean mark of 10.3 tons per load. Squadron Six broke all daily records for utilization and tons delivered with a utilization for one 24-hour period of 18.6 hours per plane per day. These records were a carry-over from the tradition of efficiency established by Adm. John W. Reeves, Jr., USN (Ret.), in the old Naval Air Transportation Service (NATS).

After unloading at Itazuke AB, Japan, supplies are processed by NOACT, transhipped through MATS to fleet carriers off Korea.

General William H. Tunner, Task Force Commander, was unstinting in his praise for the performance of the Navy units.

But statistics are fairly dry meat. They fail to present a picture of the personal effort required to establish such marks. Conditions under which the squadrons operated were far from ideal. The Vittles aircraft were flying three-minute interval, 500 feet separation, under all kinds of flying weather. Availability was more than occasionally shored up by temporarily cannablizing an aircraft in maintenance of a part to keep another aircraft flying, then transferring the same part from an incoming-to-maintenance aircraft to the one outgoing. This was possible because Navy Air Transport squadrons carry their own maintenance crews.

There was sufficient rain at Rhein Main to keep the corn in Kentucky watered for the next decade during the Vittles winter. The Engineering officer of VR-6 explained to his CO why a plane was a little slow in going back to work, "Well, Captain, the mech dropped the new carburetor in the mud and had to spend six hours dredging before he could install it on the aircraft."

Minimums at Tempelhof were low. When the aircraft broke out on "final" only slightly below the top row of windows on the apartment houses bordering the field, flying continued. However, when the boys broke out to see the janitors working in the basement of the apartments, it was considered a "bit too low."

The Berlin airlift will remain one of the outstanding feats in air transport history, and the Navy contributed greatly to the success and glory of this venture. It was a grueling, dangerous job, but it broke the blockade.

With the Berlin task terminated in July 1949, VR-6 and VR-8 returned to the U. S. to become a normal component of the now-veteran MATS command.

The Navy units in MATS provide transport capability to the Department of Defense (*Continued on page* 141)

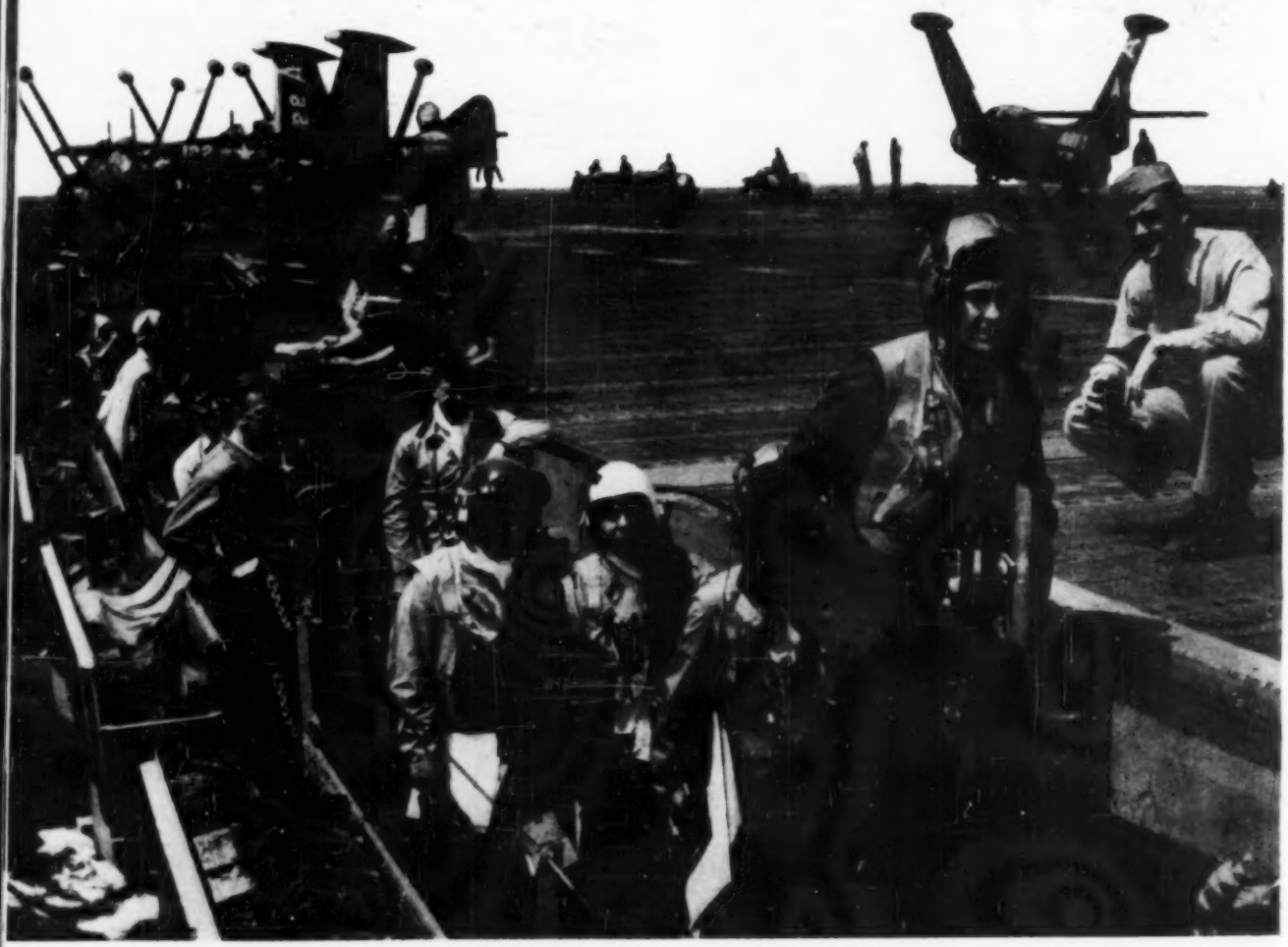
WINGS OF GOLD DON'T RUST

THE ROLLING countryside below Lieut. (jg) Ray Smith, a country boy from Route #3, Liberty, Mo., was almost like Clay County back home. It was almost like Clay County, but not quite—this was Korea, summer of 1951, and Ray was sitting in the cockpit of a speeding *Corsair* fighter-bomber as a recalled Naval Air Reserve pilot. Minutes before he and his buddies from all-Reserve Carrier Air Group 101, flying from the big aircraft carrier BOXER, had wiped out a herd of communist "volunteers" who had been pinning down United Nations GIs near an unpronounceable hamlet close to the 38th Parallel.

Now that the pilots' deadly work had been successfully completed, the GIs came popping out of their trenches "like gophers out of their holes." According to Ray, "They were waving wildly at our *Corsairs*. It was the most thrilling sight I'd seen over Korea!"

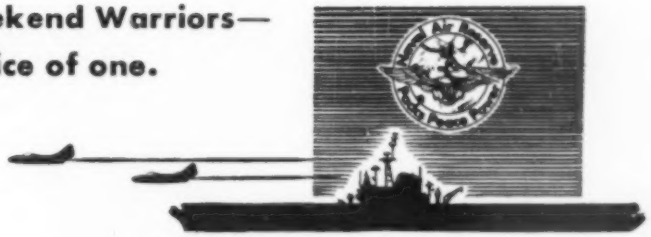
Further down the front two Marine *Panther* jets, led by First Lieut. John Riley of East Taunton, Mass., were plastering a communist half-track, killing its ten occupants. Like Ray Smith, John Riley and his wingman were recently civilians. The Navy man came back into service with his organized Reserve squadron from Olathe, Kansas, while the Marines came in with a Squantum, Mass., outfit.

Smith's and Riley's experiences were anything but unique. To the hard-flying twentieth century minutemen of former Reserve units in Korea this performance was routine. Their *Corsairs, Skyraiders, Panther* jets,



Navy pilot reservists, called back for Korean duty, go to flight quarters after boarding the USS Boxer in Far Eastern waters.

Our 20th Century Minutemen—the Weekend Warriors—were ready after six trained for the price of one.



Mariner and *Neptune* bombers ranged through the bloody Korean skies raining death and destruction by night and day on the invaders.

Let's go back the few short months when Ray and John were still at home in Liberty and East Taunton.

Who are these modern minutemen?

Before Joe Stalin decided to test his luck on the hapless Asian peninsula they were farmers, lawyers, merchants, traveling salesmen, and just about any of the other thousands of Americans making their livings in Kansas City, Chicago, Memphis or Dallas. Collectively they had pulled the curtain on the rising sun in the Pacific during the last war. After it was supposedly over they wanted to go home.

Once a man has experienced the pull of a powerful engine in front of him, and has lived and flown with the best of men over the seas from Singapore to Casablanca, something gets into his system. He doesn't just quit. He goes home, but he becomes a part of his nearest Naval or Marine Air Reserve squadron and keeps right on flying Navy combat aircraft one weekend a month. Even though he makes his living like any other civilian, he's still part of the Navy-Marine team. He renews associations with his old shipmates on training weekends and participates with them in the tough combat syllabus of Naval-Marine Air Reserve. Although few will say it, perhaps the greatest motivating power for his participation in the Reserve is good old fashioned American patriotism.

The Air Reserve Program of the Navy and Marine Corps encompasses twenty-one Naval Air Stations and seven Naval Air Reserve Training Units. These are located near population centers throughout the country so as many as possible can participate while pursuing their normal civilian occupations. Its heart is at the Glenview Naval Air Station, just north of Chicago, Illinois, where Rear Adm. Lucian A. Moebus, USN, and Col. Verne J. McCaul, USMC, respectively chiefs of the Navy's and Marine's Air Reserve make their headquarters.

The Moebus-McCaul team is a new one having taken over last summer, but already they are known from coast to coast. They spend much of their time "on the road" flying around their far flung bases making sure that their men are up to snuff. They closely check training procedures to insure that latest fleet combat tactics and combat lessons are carried through to the more than 55,000 reserve Navy-Marine pilots, air and ground crewmen.

Typical of the enthusiasm of the top rankers for the men of the Reserve is a statement made by Rear Adm. Doyle shortly after the first all-reserve air group went into action in Korea. "Carrier Air Group 101 has gone into action against the communist enemy for the first time," said Doyle, "and they're doing a terrific job. Naturally, we expect that from any Navy air group. This one is no exception. As a matter of fact, I would be willing to say that it is as good or better than some of those who have been out there right along."

He continued, "I cite Air Group 101 only as typical of what we expect, and are get- (*Continued on page* 145)

Members of Naval Air Reserve fly three FJ-1 *Furies* in formation near Oakland, as part of one week-end a month training.

Trained ground crew reserve technicians get a *Corsair* ready for flight duty, while stationed aboard USS Boxer, off Korea.

Landing Signal Officer directs pilot of ZP-1 airship during in-flight refueling test over a jeep carrier.

AIRSHIPS COME ABOARD

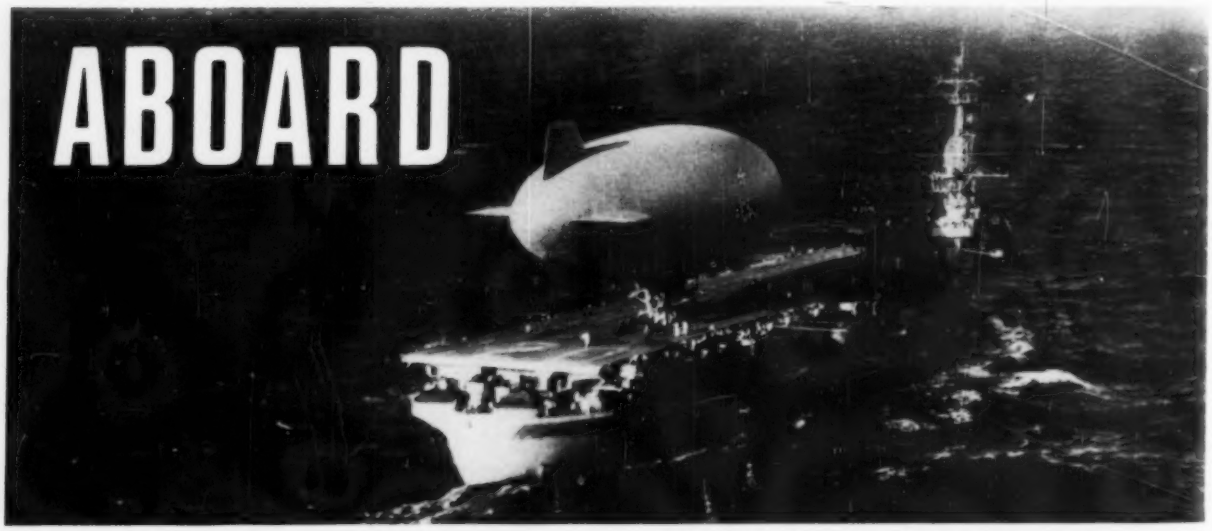
New equipment and techniques have strengthened the role of airships.

THE NAVY'S AIRSHIPS have joined the fleet as part of the hunter-killer team. Limited during World War II to coastal anti-submarine patrols and convoy escort, the airship now goes to sea with small carriers, planes and destroyers, playing an important role in this anti-submarine warfare team. This significant change in airship employment has been made possible by perfecting new flight equipment and operating techniques. These changes have made the airship a more versatile and effective weapon for hunting and killing enemy submersibles.

In total war, the United States would be extremely vulnerable to submarine attack. Not only could subs blast our merchant shipping, but they might be able to launch guided missiles at coastal cities. Such a campaign would be most effective during the initial stages of the war and could deliver crippling blows to delay our ability to fight back. It might prevent our rendering assistance to, or receiving aid from, our allies. The submarine menace is brought to mind by the early days of World War II when England was nearly isolated by German U-boats, and during which we lost many ships and enormous quantities of war materials along our own coast.

We know that many late-model German subs were moved to Russia after the war and that Russian interest in submarine warfare has continued. The exact composition of the Russian submarine fleet is not known but it is believed to represent a large part of the total. In view of this, the Navy must devote much effort towards improving defenses against enemy submarines so that any potential aggressor can not deliver an initial crippling blow before the fight begins.

As long as a submarine threat exists, airships will be needed on the anti-submarine warfare team. Submarine operation methods rely principally on the sub's ability to conceal itself below the surface to deliver surprise attacks New developments permit subs (*Continued on page* 177)



Welcome aboard the carrier. Tie-down crew securing the blimp on the deck of the U.S.S. Mindoro during maneuvers.

NAVY ON THE PROWL

Commander Art Farwell, skipper of a Navy P2V Neptune patrol squadron just back from Korea, was asked to write his version of patrol aircraft in action. Farwell is eminently qualified to tell the story. His outfit saw considerable action in Korea and he wears some medals won during World War II. Among his fellow skippers, he is considered one of the very best. He once said: "There is no valid reason for cancelling a patrol flight." This is his story, perhaps an unusual one, but one which belongs in this issue.—THE EDITORS.

"EASY RIGHT," droned the radarman, "Steady on—runway ahead four miles."

The big blue *Neptune* eased out of the right turn and started a let-down for the airport ahead. "Final check-off," called the pilot, busy correcting for the buffeting of the wind against the large tail surfaces.

"Wheels down 'n locked—flaps 30—2400 r.p.m.—mixtures rich—air direct," intoned the co-pilot, taking a last minute tightening tug on his shoulder harness. "Steady on—runway ahead two."

The plane settled rapidly as the pilot eased back on the throttles. Torrential rains drowned out the sound of the engines as it beat against the metal fuselage. Mountains towered far above the plane on all sides.

"One an'a half miles—one mile," chanted the radarman, "Come right two degrees."

"Right two," echoed the co-pilot, watching the radar altimeter drop below 300 feet.

"Field elevation 19 feet—I'll take her to 150 feet and a quarter mile," mentally calculated the pilot.

"One half mile." The needle dropped below 200 feet—175—160— "Runway ahead," called the co-pilot.

Raising his eyes from the instruments, the pilot made a last-minute alignment and eased the giant onto the concrete ribbon. The engines broke into a deep roar, as the propeller blades reversed and bit into the gusty air, braking the plane to a gentle stop.

A jeep appeared out of the late afternoon gloom and led the plane to a parking space. The pilot dropped to the ground and yelled at the driver, "Where's the gas truck?"

"Cripes," responded the shivering chauffeur, "We're all buttoned up here—there's a typhoon comin'! Hop in and I'll take ya to Base Operations."

At Base Ops the Duty Officer eyed the Navy pilot with raised eyebrows. "Just what in the devil are you doing here?" he asked. "The field is supposed to be closed; we're ready to evacuate the tower before it blows down. All the aircraft are hangared, along with the GCA unit and the gas trucks, and you come breezing in here like it was a sunny day in May. Don't you know there's a typhoon heading for this field?"

"Listen," said the pilot wearily, (*Continued on page* 160)

BEATING OUT THE BUGS

New, untried planes are put through their paces at Naval Air Test Center until the bugs are wrung out

R. L. Hensell, head of the antenna section of the Electronics Test Division, checks plane model during radiation test.

BUPERS (BUREAU OF PERSONNEL) big brass wondered how one interviewer was able to pick a consistent 100 per cent average of good specialists. They asked him what his secret was.

His answer was simple, "It's easy. I just take the boys who can say, 'Yes' to these two questions: Did you specialize in this field in college? Are you a Phi Beta Kappa?"

Unfortunately even in this day of modern technology, aircraft don't come equipped with Phi Beta keys. However, they do come with half million dollar price tags, and minus a money-back guarantee.

Inasmuch as half million dollar chunks are hard to come by in the Navy, even in this day of billion-dollar thinking, it behooves the Navy to screen their aircraft purchases carefully indeed. There are other considerations besides the money. One of the prime ones being that wars are not won by second-rate airplanes. They have to be in first place.

The Naval Air Test Center at Patuxent River, Maryland, is the outfit that insures that planes bought by the Navy are up to snuff, i.e., the best. When an airplane gets through Patuxent it has received its Board of Inspection and Survey degree and is a qualified member of the fleet. If the plane doesn't pass, production models won't be costing the Navy a half million rocks, because the Navy won't be buying that brand.

The first order for a new type is normally for three aircraft only. Formerly, when the pressure was somewhat less, these airplanes would receive extensive tests at Patuxent prior to production purchase. In this day of faster airplanes there is hardly time for leisurely decisions. An aircraft is usually put into production after preliminary tests by contractor and Navy test pilots.

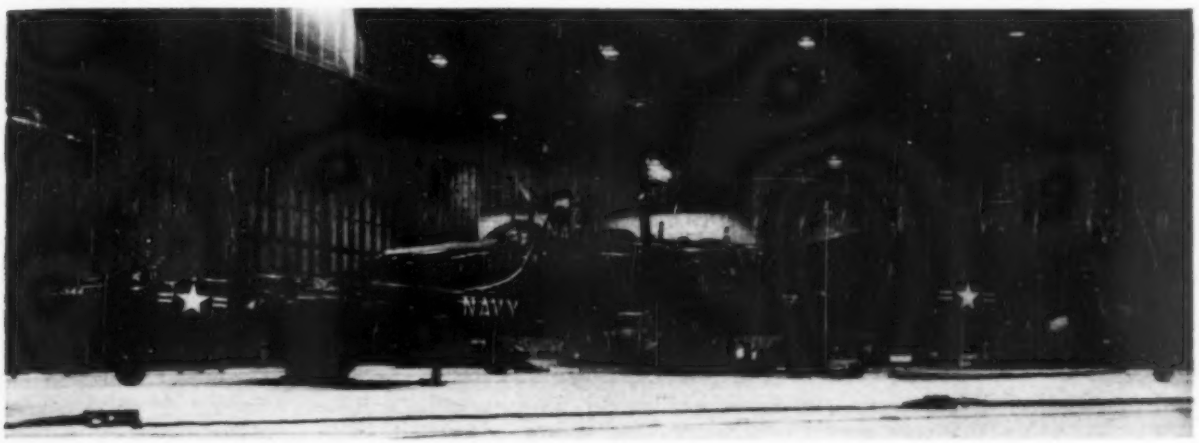
This doesn't mean the Navy is buying a pig-in-a-poke. It isn't necessary to polish off a bottle before knowing whether its good or not. A few sly nips will do the job.

The decision whether to buy or not to buy is only one of many functions of the Naval Air Test Center. The test work, even after a plane has reached production and arrived with the fleet, may continue many months.

Five test divisions at Patuxent will get a crack at the new aircraft before it receives the final stamp of approval, Flight Test, Tactical Test, Service Test, Armament Test and Electronics Test. The first unit to be turned loose on the new aircraft will be Flight test. Reason for this division receiving top priority is obvious, the number one prerequisite for any airplane these days is that it will fly--and fly well—and that is Flight test's job to determine.

In the days of yore, when stability was just a term applied to an easy-going wife, there were planes built which didn't fly very well. The only way to verify this elementary fact in those days, was to fly it. Those were the days when a test pilot really earned his money. Today, however, with all the research and design facilities made available to all manufacturers, along with the hard-earned knowledge of 50 years of aviation, all modern aircraft are aerodynamically sound. However, in this day of competition a new plane must be capable of flying better than planes preceding it.

Television cameras are used by NATC to transmit the actual electronic and other tests from shop to shop in the sections.

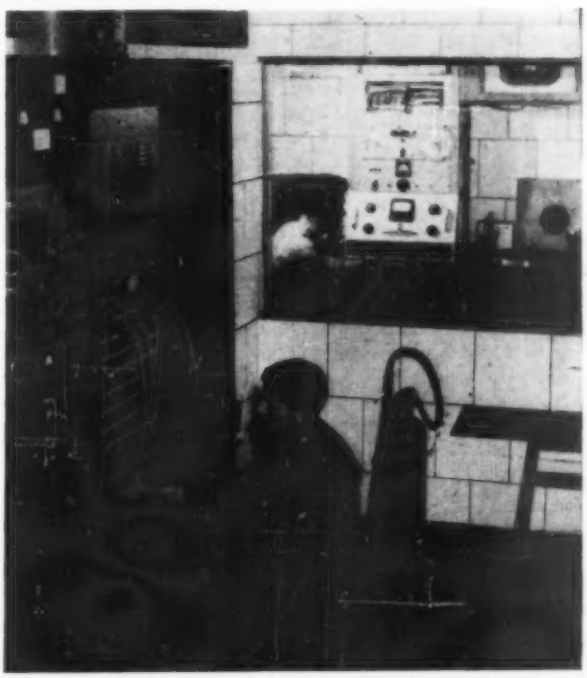


This huge electronics hangar at Patuxent has been known to have 170 separate projects going on simultaneously.

Of course, it can be assumed that a new flying machine will have certain advantages over an older model. On the other hand, aviation like everything else in the world, largely consists of compromises. An airplane capable of flying faster, will in all probability have to land and take off faster. The one attribute is good; the other not so good.

Flight test will ascertain whether these not-so-good factors outweigh the improvement factors. For example, no matter how good a fighter aircraft is in most respects, if it does not have the ability to operate satisfactorily off a carrier deck, the Navy can't become too interested. If a patrol seaplane is the world's best airplane in the air, it means nothing if it isn't an adequate airplane on the water. Its hydrodynamic characteristics must also be good.

Within the Flight test division there are several sections whose primary concern is to test the suitability for any new type aircraft for a particular job. The Carrier section and the Carrier Suitability section, work out the problems of aircraft destined to operate off a flat-top. In addition, the Patrol, Rotary Wing and Power Plant sections work on the problems in- (*Continued on page* 170)



Every type of recording equipment, which plays a major role in electronics tests, can be found in NATC Tower, Patuxent.

Office of Naval Research puts pure science to work to win tomorrow's battles.

Research Guarantees Superiority

IN A QUIET LABORATORY two men work on an array of tubing leading to an overgrown bunsen burner. With a gentle hiss, a flow of gas is started and a match lights the flame. With careful regulation of the gas flow, the flame settles down into a silent, steady cone of faint blue light. The lights are extinguished and a camera is started, recording the shape and size of the flame on film.

On the surface, there seems to be little connection between this quiet, well-behaved flame and the roaring inferno that pulses in a turbojet's combustion chamber when the pilot advances the throttle. Yet the flame speeds which the scientists will be able to calculate from the shape of the bunsen flame cone are but one part of the multitude of research data which have made possible the design and operating efficiency of that pilot's turbojet combustion chamber.

In this and other laboratories many such groups are at work for Naval Aviation. Some work with large compressors, pouring an avalanche of air into roaring combustion chambers, studying the effects of high-speed, highly-turbulent flow on combustion efficiency. Others sit in secluded quiet, working out in long strings of complete equations a theoretical set of rules which will explain the various phenomena.

Few of these scientists have been closer to jet aircraft than to see them whipping overhead at 20,000 feet—some have never even ridden in a plane. But it is the foundation which they are building with painstaking care that makes possible the creation of thousands of horsepower where only hundreds existed before.

Perhaps the laboratory and the slide rule are not as glamorous as sitting behind the throttle of a supersonic jet job, but without them such a machine would be impossible. More than 1500 of America's top research scientists are working on more than 1200 projects of the Navy's Office of Naval Research to find out the hitherto unknown in fields ranging from nuclear physics, metallurgy and aerodynamics, to mathematics, electronics and psychophysiology.

The Office of Naval Research, or ONR as the boys in blue call it, was created by Congress after the last war to coordinate the scientists' efforts as they carry on research for the Navy in leading universities and laboratories.

Typical of the knotty problems met and successfully mastered, or in the process of being mastered, are: Which type of crash helmet best protects a pilot's head?; What metals can combine the strength of steel with the lightness of aluminum and still withstand the high temperatures of jet combustion chambers?; Does the high-pitched noise of a jet engine damage the human ear—and is it the intensity or the pitch of the sound?; Could control of airflow friction over aircraft wings increase rate of climb and range?; And could electronic computers expedite mathematic testing of jet engine parts?

If one were to step into another of the many ONR laboratories at this moment, he would find more scientists at jet fuel research. Not only the testing and improvement of gasoline and jet fuel, but a whole host of compounds, some of which have been familiar only to the chemist, and some of which are new even to him. The visitor would see white-coated chemists carefully transferring a clear liquid from a maze of complicated apparatus into a small, insulated tank. This is carried over to a rocket test pit where a small rocket motor rests on a steel stand, surrounded on three sides by reinforced concrete walls. The tank of new fuel is carefully connected to the system, and the test engineers move into the heavily protected control room, where they can observe the motor through a series of mirrors.

After a final check the warning siren sounds, there is a hiss of pressurizing gas and, at a touch of the firing button, the motor starts with a throaty roar. In the control room pens on the recording instruments trace thin red lines on the charts. At the completion of the run these records are removed to permit the analysis of the performance. Some years from now, when the pilot of a high-altitude interceptor sights his target and hits the rocket switch for that extra burst of speed, this may be the substance that goes whirling into his rocket chambers.

One of the bottlenecks in jet engine production is the testing of the thousands of component parts as they roll off the assembly line. This exhaustive testing of each part and each assembly is time consuming and expensive. Easier ways have been, and more, are being found to make the job easier in both time and money.

Mathematicians under ONR contract have begun to work on this problem, to see whether the new high-speed mathematical computers might not make short-cuts possible. These almost human mechanical brains might make a single check of each engine, with every K^{+1} engine given the full double check, if the number K can be chosen in such a manner as to eliminate the cost of a wrong decision. This seemingly straightforward problem leads to some highly difficult mathematics which research scientists in computer design and theory may someday resolve.

Since the days of the Wright brothers, aerodynamicists have been interested in the flow of the air over a plane's wings. For many years they have known that friction causes a certain amount of air to cling to the wing, building up to what is known as a "boundary layer." This obstructs the passage of air over the wing surface, causing drag and influencing normal air flow. Control of the boundary layer would greatly improve aircraft performance.

For example, lift would be increased and stalling speed would be reduced. The increased lift would also make possible lower flying speeds, shorter take-off and landing runs, and greater pay loads. These results could be expected from the use of a boundary layer control (BLC) during take-off and landing. Continuous usage could give longer ranges due to the reduction of drag, shorter turning radii and increased rate of climb.

Proper control of the boundary layer also might open new possibilities in the high-speed range. This would increase performance at high subsonic and supersonic speeds. In addition it is not too improbable that by controlling the boundary layer over the wing, movable controls might be eliminated altogether.

To aid a more complete understanding of the problems involved, the Air Branch of ONR began a complete survey of all work which had been done to date in BLC. The results obtained were so promising that ONR accelerated its own program in this field.

The survey showed that the Germans had spent a great amount of work on the BLC program and had made much progress by the end of World War II. BLC is no longer purely a theoretical problem but an applicable actuality which can be put into modern aircraft providing greatly increased performance.

To be specific in what this means in aircraft development, computations on a 20,000 pound aircraft show that an additional 1500 pounds would probably be adequate to equip such an aircraft with BLC. This equipment could almost halve its take-off run and materially reduce the landing run. If this (*Continued on page* 179)

A germ-proof technician enters the sterile chamber at Lobund Institute to inspect the germ-free animals kept there for study.

Nobody gets hurt in the new synthetic trainers the Navy is using; besides, they are saving the taxpayers' money.

SIMULATORS ACCELERATE TRAINING

Instructor operates the electronic computer which simulates actual flight conditions in F9F while trainee, in cockpit, "flies."

Sitting in the control station of the operational flight trainer of the F3D, the instructor guides a student through his paces.

THE LATE AFTERNOON Washington to New York Limited was rattling over the rails towards Philadelphia when two persons, previously strangers, were overheard in earnest conversation. No, neither was blonde, beautiful—and female. One was a Marine aviator from MCAS Cherry Point, North Carolina, heading home on leave. The other was a technical man from the Office of Naval Research's Special Devices Center, returning to Port Washington, Long Island, after a business trip to Washington.

Since the technician was in the business of developing synthetic training devices for Naval Aviation, and since the Marine was in the flying business, their conversation was quite naturally on the subject of mutual interest, flying—specifically the F9F *Panther* jet Operational Flight Trainer.

"Sure I've flown it," said the Marine in reply to a question by the training devices man. "I had four hours in it before I took up an F9 for the first time. Naturally, I'd given myself a good cockpit checkout in the plane on the ground before I even knew they had the trainer.

"What surprised me most when I got into the trainer, was that there was no darn difference between it and the cockpit of the real F9 that I'd sat in before on the ground. I even felt like I was flyin' when they got it wound up. After my four hours in the trainer, I felt right at home on my first jet flight in the real thing."

Like anybody when his "baby" gets a compliment, the man from Special Devices Center was more than pleased to hear this coming from a pilot that had "flown" the synthetic F9F right on terra firma and then took the real plane up with ease, comfort and safety.

This gadget they're talking about—the F9F *Panther* jet Operational Flight Trainer—it's simply a duplicated F9F cockpit hooked up to an instructor's console and an electronic computer. Without ever leaving the ground, which it can't, the instructor can simulate all conditions of flight so that the trainee (pilot) actually feels that he's flying. It is so real that if the pilot doesn't push the right button or lever in the cockpit, the same reaction would take place as would if he were flying a real plane—except nobody gets hurt in the trainer.

The Naval Air Station at Quonset Point, Rhode Island, is using one of the trainers to check out fighter pilots in *Panther* jets. Let's bail out of the Washington to New York train and skip up to Quonset for a ride in the Operational Flight Trainer with Lieut. (jg) G. K. Gregory, a pilot of Fighting Squadron 73, during the early phases of his *Panther* jet check out. His instructor is getting him started, "Go ahead and take off.—At 120 knots pull your stick back.—When you're airborne raise your wheels."

Gregory acknowledges the orders, performs each operation, and watches his airspeed (*Continued on page* 164)

THEY STEP INTO SPACE

Navy's experimental parachutists walk on air so jet pilots can be let down easy in case of trouble.

SEVEN MILES west of the Naval Auxiliary Air Station, El Centro, California, a silver R-4D, flying at an altitude of 3,000 feet, rolls out of a turn and steadies on a southerly course. The plane banks gently now and then as the pilot receives directions from a helmeted man peering through the open door near the tail. The desert, far below, drifts slowly by, a lazy procession of sand, thinly scattered bushes, and more sand. A white circle, large even when viewed from 3,000 feet, moves into view. The helmeted figure gives a short, last-moment instruction to the pilot, then waves his arm. Instantly there is a swift, orderly rush as one, two, three, four, five, six, seven, eight men hurl themselves through the door and plummet earthward. Seconds later eight white canopies blossom in the morning sun. With an almost imperceptible sound of relief in his voice the jumpmaster calls "Jumpers away"; and the plane starts a gentle turn to get in position for another run.

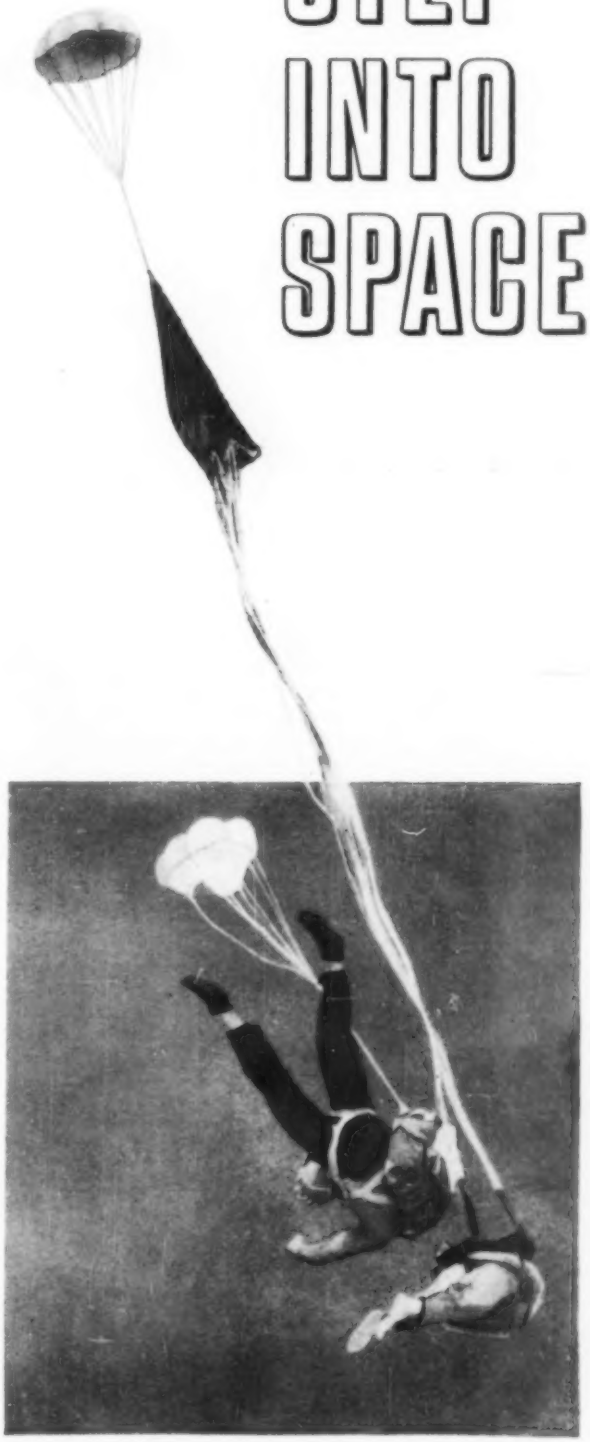
In almost any other part of the United States the sudden appearance of eight parachutes in the sky would attract widespread attention. But not to the people of El Centro. To them it's old stuff, merely part of the Navy Parachute Experimental Unit's routine work.

Some of the jumpers were new at the game, and some were old hands; some were jumping to gain experience or be qualified, and some were testing new equipment; some were wearing back packs, and some had seat packs. All, however, had one thing in common—a chest pack. This is "just in case". For every man in the Navy who makes a premeditated parachute jump carries with him at least two chutes. Some men have carried as many as six. Parachuting—while far from suicidal—does have the element of danger, especially experimental parachuting. That's why each man must have a reserve chute. That's why the Navy gives each man "jump pay", that extra bit of green stuff each month. That's why each man must have in him that little extra nerve, courage, moxie—call it what you will—that enables him to step through an open door onto thin air and consider it part of a day's work.

Back in 1944 at Lakehurst, N. J., the Navy organized the Parachute Experimental Division to take care of the parachute test work until its original complement of one officer and four men was no longer adequate. And no longer was Lakehurst a satisfactory location. So the United States was searched for a more suitable location. Eventually El Centro with its 360 flying days per year, its flat and sandy desert, its nearby Salton Sea, and its already existing air field was selected. Today the unit consists of ten officers, four civilians and 183 men.

Further expansion is imminent; for the Air Force is also moving its parachute test unit to El Centro. There the two activities will work together as the Department of Defense Joint Parachute Test Facility. The resulting coordination of effort will prevent the duplication of research and test, which in turn will save time and lives and the taxpayer's money.

A parachute is not a haphazard collection of nylon cloth, lines and straps. Each shroud line, each reinforcing band, each row of stitching has a specific purpose. It is as carefully designed as an airplane or a steamship. And as in aircraft and steamship design, the engineers, working from mathematical formulae and from years of experience, know pretty much (*Continued on page* 154)



WOMEN ARE VERY EFFICIENT SAILORS

WHOEVER SAID, "Women: you can't get along with 'em or without 'em!" wasn't thinking of Naval aviation which gets along with 'em fine.

During World War II about 25,000 WAVES were assigned to duties in naval aviation. Of this number, 8,500 had received specialized aviation training as aviation machinist's mates, aviation metalsmiths, link trainer instructors (navigation and blind flying instructors), control tower operators, parachute riggers, aerographer's mates, pigeonmen (trainers of homing pigeons), aviation instrument repairmen, fixed and free aircraft gunnery instructors, camera repairmen and transport airmen (flight orderly).

Women officers were trained as instructors in aerological engineering, air navigation, air combat information, communication procedures, photographic interpretation, aircraft recognition, radio radar administration, aviation gunnery, celestial navigation and crash analysis.

After the war, the WAVES and the Marines' WRs were completely integrated into the service and a peacetime nucleus was formed. Thus, the women were giving much needed help and, simultaneously, being trained in new fields. In this way all their capabilities, aptitudes and limitations could be studied and their employment expanded before a national emergency arose.

This concept has been actually carried out and is clearly shown in the naval aviation training program. To the aviation ratings in which women served in World War II have been added: aviation electronics technician, aviation electronicsman and photographer's mate. Aviation

After thorough training in all phases of aviation, this Wave was able to specialize for her Link Trainer instructor rating.

Two weatherwomen of the Navy, Aerographer's Mates, are about to take radiosonde recordings by releasing balloon.

Women can match efficiency ratings with men in 21 rates— from trainers of pigeons to gunnery instructors

machinist's mate and the aviation metalsmith have been subtracted because careful study showed that, although the girls were good at these jobs, it was not practical to move them around with the air squadrons.

Approximately 10 percent of all women recruits selected for advanced training go to the Airmen School for an eight-week course of indoctrination in the intricacies of naval aviation. The recruits' preference for aviation service runs high, so final selection must rest with the classification experts and the results of batteries of aptitude tests.

The Airmen School introduces the trainees to naval aviation and prepares them for specialized aviation schools. It gives them a general knowledge of each aviation rating in order that they may choose one in which they are interested and for which they are qualified.

The school is divided into four phases. The first deals with aircraft familiarization: the history of aviation; theory of flight; plane types and designations; safety precautions; nomenclature of land and sea planes; taxi signals; spotting and securing aircraft; flight deck operations; launching and beaching, anchoring and mooring seaplanes; cockpit checkout and starting engines; and plane recognition.

The second phase is survival and emergency equipment: oxygen, safety belts, parachutes, life jackets and rafts, and emergency signaling equipment. Methods of air-sea rescue are taught, as well as fire fighting and rescue procedure from aircraft.

The third phase concentrates on basic skills and related information. Refresher courses in mathematics and physics are conducted along with courses in blueprint reading and layout; use of hand tools; interphone procedure and phraseology; and (*Continued on page* 152)

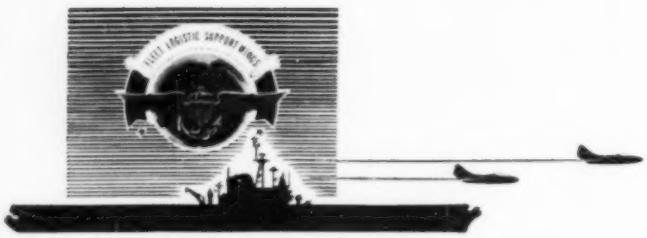
Prior to take-off, Naval Aviators have their flight plans checked and filed at the Operations Desk, very ably manned by a woman.

Feminine Seaman Apprentice finds out about the Electrical system of the Martin Electric Turret, extensively used by NAV.

Of the many ratings opened to women in Naval Aviation, the Control tower operation is found to be a "natural" for them.

Aviation Storekeeper checks her cardex carefully so she knows exactly what supplies are on hand and what has to be reordered.

Pilot checks with WAVE Aerological Officer on prevailing weather between his point of departure and final destination.



LOGISTICS

Tank-busting bazookas flown to Pusan by Fleet Logistics Air Wing saved Marines.

WHEN THE NORTH KOREAN "Made in Russia" tanks nosed south of the 38th parallel they came within range of our dreaded anti-tank bazookas of World War II. The invading tanks came within range. "Swoo-sh" went our bazookas from the ground and from the attack planes we had in the area.

On came the tanks relentlessly. The old bazooka rockets just bounced off the tough hide of the T-34. Something had to be done as the South Korean defenders fought their way back to the Pusan perimeter. Pusan was fast becoming a candidate for the Corregidor of Korea.

But the foothold at Pusan was saved. This time support arrived, in many cases, delivered to the Marines by air. The first 200 3.5 shaped-head bazooka rockets were delivered by a Navy Fleet Logistic Air Wing aircraft.

These first 200 anti-tank rockets for the Marines did not win the war. Nor did any of the materials delivered by Fleet Logistic Air Wings or other air transport aircraft win the war. Wars are won by men and their weapons. Each weapon and each man involved in a battle contributes to the ultimate defeat or victory.

The fact that anti-aircraft ammunition and aircraft spares were not available in 1942 did not lose the Philippines. However, had air logistic support been available to the men fighting on that bloody rock, ammunition and spares *might* have contributed to the saving of the Philippines. Had there been an air transport organization in being to supply the critical items required to hold on—it might have been done. By what margin is a battle won or lost? The last bullet fired may be the one to spell victory or defeat.

This time Fleet Logistic Air Wings planes and crews joined United Nations, MATS and commercial aircraft to furnish the support required during those early vital days until conventional transport methods caught up.

MATS was established to provide for the Department of Defense over routes of mutual interest by utilizing aircraft and personnel formerly operated as ATS and NATS. The Navy has an additional requirement for air transport for direct fleet support which cannot be accomplished over MATS routes of mutual interest. The Fleet Logistic Air Wings provide direct fleet support.

A 25,000-lb. payload of critical materials is loaded on *Mars* at Alameda for overnight 2,400-mile hop to Hawaii and Korea.

Fourteen R5D *Skymasters* were ready at time of Korean invasion to give logistic support by transocean ferrying of Marine troops.

HAVE WINGS

Logistic workhorses—the *Mars*, *Constitution* and *Skymaster*—helped reach Navy's aircraft utilization record of 8.5 hours per day.

Two helicopter fuselage sections were flown directly to Japan from Bell's Niagara Falls factory in this Marine R5D transport.

At the outbreak of the Korean conflict, the Navy had three FLAW squadrons in the Pacific and three in the Atlantic plus a ferry squadron on each coast. For trans-ocean service, only 14 four-engined R5D SKYMASTERS operated in each fleet, with the Pacific having an additional four MARS seaplanes and two R6D CONSTITUTION landplanes.

As air priority backlogs of men and material continued to build up on the west coast for movement to the Pacific, a cry went out for more planes, crews and maintenance personnel to bolster the Pacific FLAW units. Beg, borrow or steal was the theme and the Navy dug deep into its limited supply of four-engine transports.

All of the limited number of R5D aircraft operated by squadrons on the Atlantic Coast, with the exception of one which was designated to provide direct fleet support to the Sixth Fleet in the Mediterranean, were dispatched to the Pacific.

Special fuel tanks were added for long overwater flights. Some transit crews had time only to pack a few belongings and bid a hasty goodbye to their bewildered families before they were winging their way across country to take part in the aerial pipeline over the familiar Pacific routes and areas.

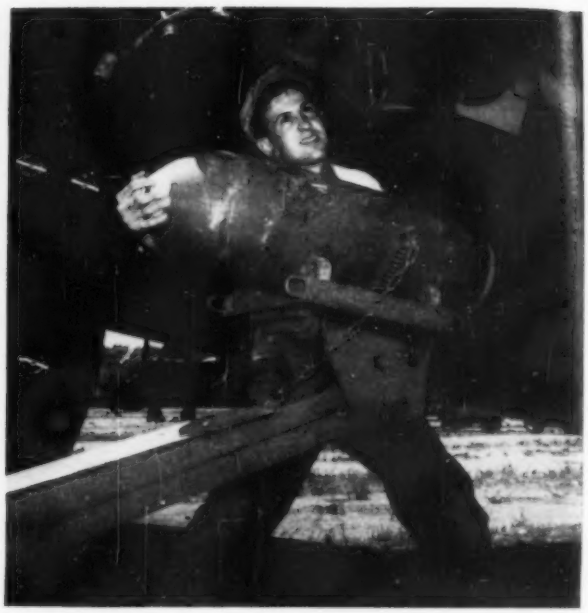
Aircraft utilization in the Pacific FLAW squadrons climbed from the 3 hour per day pre-Korea figure to 5.5 hours per day by 1 August, to 7.25 hours per day by 1 September, to a top of 8.5 hours per day by 1 October. This reflects a mark hard to match.

Within a short period, four FLAW planes per day were arriving in the combat area. Four planes per day isn't much, but it meant that 24 planes had to be en route continuously between the west coast and Japan in order to make those four arrivals possible. Not until the pressure eased after normal transport methods began meeting the demands, did FLAW utilization level off to around 6.0 hour utilization per day.

Again, figures alone fail to reflect the effort involved. Crews which had been flying approximately 100 hours per month pre-Korea had to take up the slack until mobilization caught up. A normal maintenance personnel pool had to be spread thinly through the Pacific to meet service requirements over the long route west. Schedules no longer applied. To crews and planes the recurring orders were: land, service, eat and shove off. A radioman with a logbook already showing 200 hours for the month spoke for all as he crawled aboard for another flight, "Cripes, I keep telling you, this ain't my home." But they kept moving. Supplies kept moving.

The Mars squadrons turned in an outstanding contribution even in a period when normal operations were "maximum effort." Flying the giant 168,000 pound Martin seaplanes, the squadron raised their 3 flights per week to Honolulu to 7 trips a week. In addition, they took on a number of special flights direct to Japan from the west coast. Aircraft utilization in this squadron climbed to a peak of 13.0 hours per plane per day. With payloads averaging between 16 and 24,000 pounds—two to three times the load capacity of an R5D over the same route—between Alameda and Honolulu, this effort counted heavily. When one of its four (*Continued on page* 166)

Supply of 50-caliber cartridges are put in nose of Navy plane.



Aviation ordnance man loads a 250-lb. bomb on F8F *Bearcat*.

BOMBS, BULLETS

The armament section of Naval aviation provides the fighting airmen with the deadliest of tools.

NO PHILOSOPHY pays off quite so well in warfare as getting there first with the most. The initial part of this policy, so far as Naval aviation is concerned, is left to designers and builders of combat aircraft. Phase two of this strategy—delivering the most—is a problem of the Armament Division of the Bureau of Aeronautics.

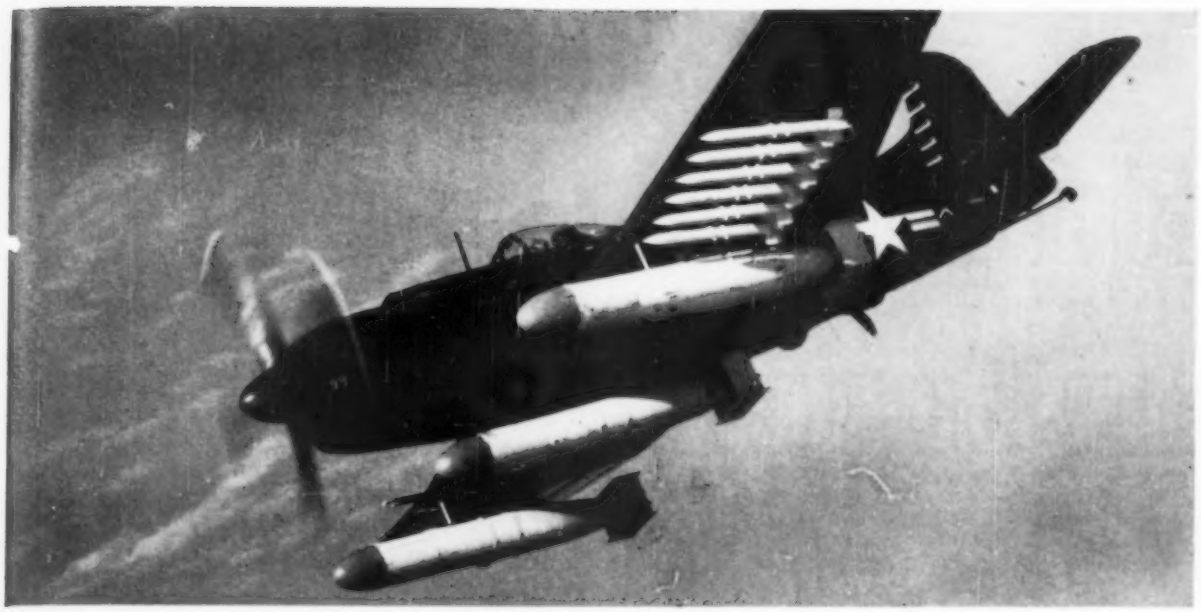
The weapon problem has been successfully solved by individuals down through the ages to meet a particular situation. David took care of his armament problems with a sling-shot, a good eye and a strong right arm. This may be defined in the simplest terms as the single-shot method.

Strategists of the American Civil War used a slightly more sanguinary approach, namely masses of bolts, bits of anchor chain and metal scrap, fired from a cannon. This may be described as the scatter-shot system.

Generally speaking, these two time-honored techniques of armament, still serve to illustrate the two extremes of philosophy that have governed armament design since the beginning of blood-letting. It involves a question that must still be solved on the battlefields, on the oceans, or in the air.

Factors which determine the system to be used include a survey of the military situation, weather, vehicle capabilities, target vulnerabilities and personnel abilities. Both

AF-2S attack plane's bomb bay opens as it peels off in preparation for a dive during armament test run at NOTS in Inyokern.



A 9,000-lb. payload, including 3 torpedoes, 12 rockets and 4 cannon, makes the AM-1 one of the most heavily-armed carrier-based bombers.

S and ROCKETS

the single-shot and the scatter-gun methods are used, dependent upon current conditions.

Modern examples of aviation armament, in naval aircraft, of these two types, are the well-placed single bomb released in a dive attack and the salvo of bombs released in a level bombing attack. Another example, in which we have both extremes, plus a medium type, is the 11.75" Tiny Tim rocket (the single shot); pairs of 5" Holy Moses rockets fired at close intervals (the medium type); and a salvo of say 24 of the 2.75" Mighty Mouse rockets (the scatter shot).

The advent of the jet airplane has multiplied the problems in the aviation armament field although the basic choice remains the same. Decisions revolve about the calibers, rates of fire, and muzzle velocities of guns; sizes, velocities, and numbers of rockets; weights, explosive characteristics, and numbers of bombs; and accuracies of fire-control systems.

When World War II ended, the armament of the fighter, light attack, and patrol types of aircraft had reached certain well defined forms. The average fighter aircraft carried 4—20mm aircraft guns which had a muzzle velocity of about 2900 ft. per sec. and fired about 750 shots per minute. Some fighters also carried four to eight 5" rockets for air-to-ground or surface use. These rockets were known as AR's or "Holy Moses" and had an all-burnt velocity of 1150 ft. per sec.

That rockets were quite effective can be attested by Lt. Cleve Null, USN, who, during the latter part of World War II fired six of them from an F6F at a large box car ferry boat near Sasebo, Japan. The rockets struck amidship at the water line, and lifted the center of the boat, whereupon, the load of freight cars rolled out at each end and found their resting place in the bottom of the sea.

This same Lt. Null, incidentally, is one of the few aviators to wear both the wings of an aviator and the combat cruise pin of a submarine—a fact which was not so planned. For when he was shot down off Saipan and paddled over to the "rescue" submarine, confidently expecting to be delivered to his carrier, he found himself a guest on a battle submarine engaged in a six weeks' cruise. And since guests are not allowed on such missions, he was given a job which at the end of six weeks qualified him for the pin.

But returning to the armament of the fighter, the latest fire control system in use when World War II ended consisted of the Computing Gunsight which gave the pilot the computed lead angle based on a range-to-target value determined by the pilot. In other words, the lead required to hit the target was arrived at by spanning the wing tips of the target plane by means of two moving pointers which the pilot manipulated with a control attached to the throttle. This procedure is known as stadiametric ranging. Its drawback lay in the fact that the dimensions of the enemy fighter had to be known quite accurately, and in that the pilot had to fly smoothly to prevent yaws and slips that would cause errors in the computed lead.

The light attack airplane usually carried two 20mm guns, three 1,000 pound bombs, and 5" rockets. The fire control was a relatively simple non-computing sight.

The patrol types carried a somewhat larger bomb load, torpedoes, depth bombs or mines. Fire control for bombing included the angular rate, low altitude bombsight and some radar bombing equipment. Defensive power for these aircraft consisted of nose, tail, upper deck and side turrets. These turrets were inhabited, carried two 50 caliber guns, computing sight similar designwise to the fighter equipment and electric or hydraulic controls.

The advent of the jet airplane (*Continued on page* 140)

Equipping the Cockpit

Navy jet pilots would need two heads and 10 arms to target and back if it were not for special cockpit devices.

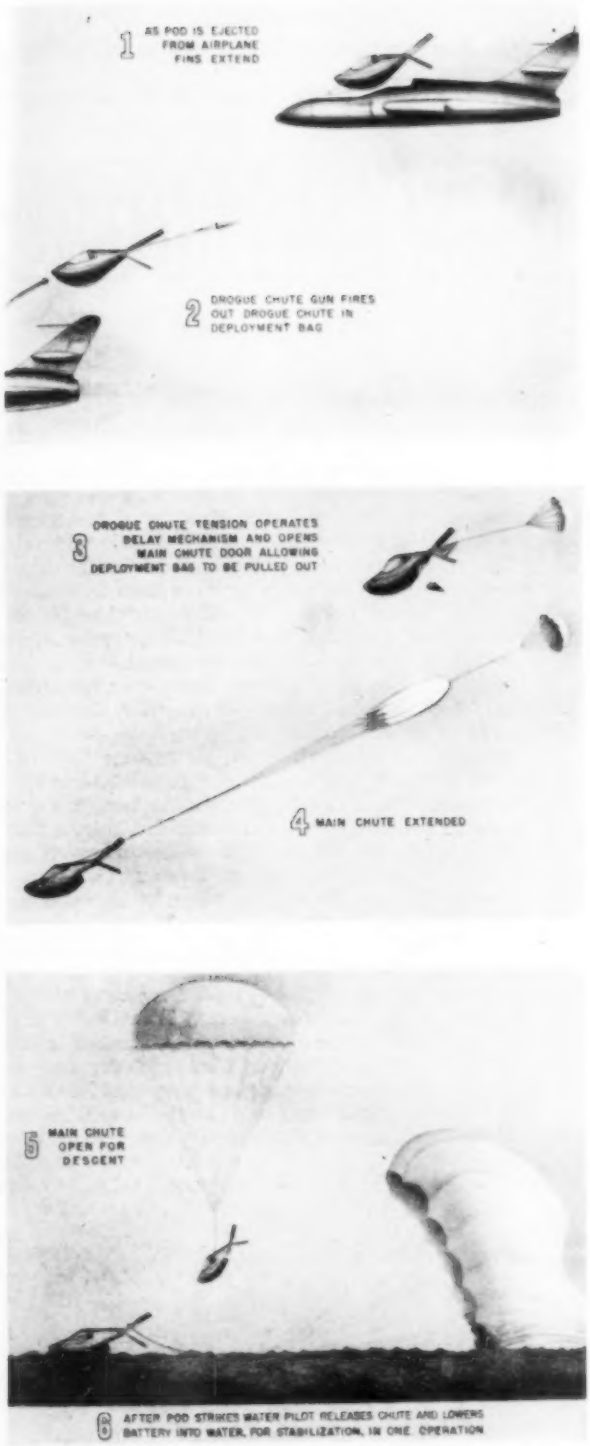
An anti-G flying suit which incorporates a pressure attachment tube designed by Airborne Equipment division of Navy's BuAer.

Navy pilots, about to fly a mission, fastening on special gear which makes their job of flying fast jet planes much easier.

ONCE UPON A TIME it was easy for a man to walk up to an airplane, get in, fly around and, if he got into trouble, step out with a parachute. However, with modern Navy airplanes going so fast, so high, and so far, those three once-simple acts have become enormously complicated.

Airborne Equipment is the division in Navy's BuAer which wrestles with this get-the-pilot-in . . . keep-him-alive-and-get-him-out problem. The fact that a human has no built-in gear for flying at supersonic speeds at multi-mile altitudes forces Airborne Equipment to fit him out so that his body will not be literally torn apart by wind blast or sudden change of pressure; his mind will not be blacked out by the pull of gravity; and his ability to reach the enemy, hit him, and come back home will not be destroyed by cold, heat, sickness, or fatigue.

For instance, not even a Navy pilot is strong enough to budge the control surfaces of a jet airplane in flight. The job calls for hydraulic pressure—as much as 3,000 psi—to do it for him. So Airborne Equipment gave the pilot the power to control his airplane. But, Airborne Equipment couldn't take away from him that instinct of all good pilots—the feel of wind over the surfaces. Given simply the power to move aileron and elevators resulted in destruction of the aircraft—the pilot, not being able to "feel" anything, could tear the plane apart. In order to save airplanes and pilots, BuAer added a feed back system to its power operated flight control system. This gadget puts the "feel" back into stick and pedals although the pilot actually has no direct control. This extremely complicated device takes care not only of the amount of control displacement but the rate of it as it varies with speed and


1 AS POD IS EJECTED FROM AIRPLANE FINS EXTEND
2 DROGUE CHUTE GUN FIRES OUT DROGUE CHUTE IN DEPLOYMENT BAG
3 DROGUE CHUTE TENSION OPERATES DELAY MECHANISM AND OPENS MAIN CHUTE DOOR ALLOWING DEPLOYMENT BAG TO BE PULLED OUT
4 MAIN CHUTE EXTENDED
5 MAIN CHUTE OPEN FOR DESCENT
6 AFTER POD STRIKES WATER PILOT RELEASES CHUTE AND LOWERS BATTERY INTO WATER, FOR STABILIZATION, IN ONE OPERATION

One of the most important projects tackled by Airborne Equipment division was how to protect the pilot who must bail out while traveling at supersonic speed. This series of diagrams shows the U. S. Navy approach to that very important problem.

acceleration.

Of course, the Navy has drifted away from the "seat of the pants" type of airplane operation. In fact, the seat of the pilot's pants is considerably removed from the airplane. He sits on a para-raft which gets him down safely and then provides him with a boat complete with signaling and survival gear. He wears not only a pneumatic life vest, but an exposure suit to keep him warm if he goes down into water below 50° F. He also wears an anti-"G" suit so that his body can take far more than the 3 or 4 "Gs" he could stand without it. The old baseball cap has been replaced by a glorified football helmet complete with oxygen mask, communication facilities, skull protector and windshield wipers.

The Navy safety belt and harness holds together under as much as 40 "Gs." And Navy pilots are no longer subject to being torn to pieces or drowned by their parachutes when, because of injury or simple lack of strength, they can't collapse the canopy. The Navy has developed a canopy release by which a man can get rid of it as soon as he touches land or water.

The modern Navy pilot is, necessarily, an ungainly thing on the ground and, to Airborne Equipment, he is a problem in the air. In the world into which he is going—a world as cold, silent and remorseless as the abyss of the sea—he must live, think, coordinate.

Simply to keep a man alive at an altitude where his lungs demand 100% pure oxygen presents problems in fields ranging from physiology to metallurgy. The pressure cabin is only a partial answer for, in combat aircraft, puncture of the cabin with pressure high above that of the outside could result in a fatal explosion inside the pilot. To avoid this, cabin pressure is kept within a safe range of outside pressure, the pilot wears a pressure sustaining suit, and is equipped with an oxygen supply completely separate from that of the cabin.

To think clearly and coordinate thought and motion the pilot must be kept warm when the temperature around him is minus 100 degrees Centigrade. The Navy does this with a thermostat relay-controlled valve which mixes hot and cold air.

A pilot in a Navy jet is a busy man but if it weren't for BuAer's fantastic devices a pilot with two heads and ten arms couldn't fly a jet to the target and back. BuAer doesn't even leave it up to the pilot to choose his speed and altitude. Instead they give him a machine which solves range and endurance problems at the drop of a few factors. BuAer has even sponsored the development of a thing called the angle of attack indicator which not only shows the pilot how much more he's got before a stall, but if he can't read and keeps crowding it, shakes the stick or starts a siren.

The brains in Navy's BuAer are no longer satisfied with airplane instruments which only indicate; they want controllers. After all, they argue, the airplane is getting faster and faster but the pilot's mind seems to proceed at the same old rate. And, since the pilot's purpose is still the same—hit the enemy—BuAer wants him to be able to give his entire attention to that, and little—eventually, they hope, none—to flying the airplane.

Even with this complexity of automatic gizmos, even with the dream plane of the future in which the pilot will function only as a judge of targets, human skin comes off if blown against hard enough. This problem—wind against skin—can be solved simply: get behind something. But when you add to it the problems of altitude, of how to keep gases in the human body from creating internal explosions, of how to get a man out of a metal contraption going faster than sound, getting behind something is no longer the answer.

To BuAer's Airborne Equipment Division all these sticklers are bunched under How To Get Out. Up to 300 mph and 45,000 feet a man can get out and go on down with no ill effects, theoretically. Increase that speed to around 600 mph and our boy finds the climb-out-and-watch-the-tail process difficult (*Continued on page* 158)

The air Navy teaches its aviators that safety is right first, last and always.

SAFETY IS YOUR B

FLIGHT SAFETY is everybody's business in naval aviation. If there is some shortcoming in the pilot's training, a small failure on the part of a maintenance man, or lack of coordination and dexterity by the pilot, all the months that go into training an airman and building a jet are lost.

Let's look at an individual accident and see how it is investigated, reported and processed from the time the siren sounds and the crash trucks speed toward the wreckage until it is labeled "finished business." Actually, this last term is a misnomer, for aircraft accident records are of value in pursuing cause studies after the individual accident report has been completely processed.

As soon as the crash and fire crews have done their work, a photographer is on hand to obtain a pictorial record of what was left of the plane. A guard is stationed to protect the wreckage until certain preliminary portions of the investigation are complete.

Let's assume that this accident occurred as a result of engine failure shortly after take-off. The pilot had very little runway left, hit with wheels retracted and slid down a steep embankment into a drainage ditch. Here the plane stopped abruptly enough to buckle the fuselage and cause strike damage.

One of the first persons to examine the wreckage is the squadron flight safety officer, usually the third or fourth most senior officer in the squadron complement. He will note the position of all controls and switches and ask the pilot (assuming that he is available for questioning) to tell him briefly what happened and what switches or controls were moved during and after the emergency. Later the pilot will be required to prepare a detailed written statement of the facts and circumstances surrounding the accident.

The squadron flight surgeon will also be gathering information from the wreckage. He will pay particular attention to accelerometer readings. If ring-type dynamometers have been installed in the shoulder harness and lap belt, he will remove them, make a preliminary examination, and forward them to the Bureau of Aeronautics where the impact forces to which the pilot was subjected can be accurately determined.

The squadron commanding officer will now designate a three-man aircraft accident investigating board. The make-up of this board will vary with the type of accident. In this instance the membership would probably include the squadron engineering officer or his assistant, the flight safety officer and one other officer. If the pilot has been injured, even slightly, the squadron flight surgeon will be designated as a member of the board. When practicable, all members of the accident board will be senior to the pilot involved.

When the board is satisfied that they have obtained all the pertinent information available at the scene, the wreckage will be moved with care not to further damage any parts which may provide a clue as to the cause of the engine failure.

The engine itself will normally be removed and placed in a test stand. Various accessories such as carburetor, fuel pumps, magnetos, etc. will be removed and sent to shops where they can be bench-checked to determine whether or not they were functioning properly. Samples of the fuel will be analyzed to determine whether or not any water or foreign matter may have been introduced into the fuel system. Oil pumps will be checked for the presence of metal particles. Throttle linkage and controls for propeller and mixture will be examined.

Somewhere in this group of tests there is a very strong probability that the discrepancy which led to the loss of power will be determined.

For purposes of illustration, let us assume that part number NF-9999.555, gasket, fuel pump, is found to have been improperly installed during a routine change several days prior to the accident. The aviation machinist mate who performed the job also handled the fuel pump change on several other squadron planes. The question immediately arises, "Is this the only instance of improper installation?"

Other squadron planes are checked and the investigation shows that the fuel pump gaskets were correctly installed in all but one other airplane. Shop records show that the fuel pump change was accomplished on both of these planes by the night check crew on the 28th of the month. The chief petty officer who normally inspects the work of the night crew was granted special liberty on the 28th because his wife had to go to the hospital where she gave birth to a seven-pound future blue-jacket. In hi

Illustrated by R. Osborn

absence a first-class petty officer was in charge and he admits that he was not too familiar with the installation.

With the discovery of the cause of the accident, one might think that his particular investigation would be complete. However, such is not the case. At the time of accident a preliminary dispatch has been sent to the Chief of Naval Operations giving such details relative to the accident as were known at the moment. Now that the exact nature of the cause has been determined a complete aircraft accident report is forwarded. One copy goes direct to the Flight Safety branch in C.N.O. while another makes it way up the chain of command.

The same change order relative to fuel pumps has gone to all squadrons equipped with this particular model plane. If the error in the installation of the gasket is one which appears easy to make and difficult of detection after the job is complete, it may be advisable to caution other squadrons by speed-letter or dispatch. A quick check of each of their planes may prevent a similar accident halfway around the world.

In the Flight Safety branch in Washington the accident report is studied and coded, so that all the pertinent information may be recorded on a specially designed 8x10 card. This card is punched with the appropriate codes to facilitate future use in accident cause studies.

If the loss of power, in the accident which we are using as an example, had occurred a few seconds later, the results might have been quite different. Let's assume that the pilot had reached an altitude of about 450 feet when the engine suddenly quit and that on noting the loss of power the pilot became panicky and attempted a tight left-hand turn back to the field. Midway in the turn he stalled and spun into the ground. The aircraft was completely demolished in the impact and *(Continued on page 140)*

Navy's missiles with non-human brains and electronic eyes can seek, find and destroy a target

MUGU GUIDES THE "BIRDS"

Rocket boosted LARK with both horizontal and vertical wings soars at trans-sonic speeds at Naval Air Missile Test Center.

WHERE U. S. Highway 101A leaves the Pacific Ocean and veers inland toward Oxnard, Calif., there is a long, sandy beach and lagoon called Point Mugu. Until recently, this 4,200-acre promontory was the haven of duck hunters and of artists engaged in sketching fisher folk. Now it is the center for some of the nation's most advanced experimentation in weapons of tomorrow.

On Point Mugu's beach the old Spanish cavalier, Cabrillo, is supposed to have landed. Now his "Mugu," or "Place of Landing," is seared several times a day by great blasts of flame and smoke—visible evidence of controlled energy propelling the Navy's latest guided missiles.

A revolution in naval warfare as profound and far reaching as the transition from sail to steam is embodied in the mission and achievements of the U. S. Naval Air Missile Test Center at Point Mugu. Here, the scene of the Navy's principal activities in guided missiles, the shape of things to come is clearly written in vapor trails across the blue California skies as the experimental "birds" zoom seaward from the launching pads.

Two things spawned by World War II pushed back man's horizon and raised his ceiling beyond the limit of imagination. The requirement of enormous power in a small package was solved by the rocket and ram-jet engine. The requirement of a non-human brain and the ability to see without eyes was solved by electronics. The defense of America has justified the expense of these machines.

No men on earth want peace more deeply, fervently, than the men of the U. S. Navy. However, the Navy is an instrument of defense and these men, working always closer to a means of creating destruction of any possible enemy, realize that if a few men can be stopped from making war, guided missiles in a peaceful world could become guided messengers, carrying only knowledge and wisdom.

Until this time comes, there is a possibility of guided, atom-armed missiles. There is now no sure defense against them.

At present there are four general types: surface to air missiles for interception and destruction of things in the air; air to surface types for attack against things on the ground on in the sea; air to air missiles, and surface to surface missiles.

"SKEET," pulse jet powered anti-aircraft target drone, makes 400 knots over Pt. Mugu. A warhead would make it a missile.

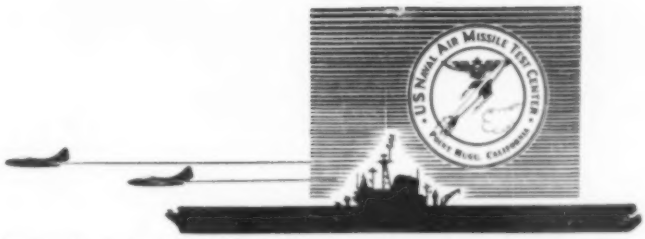
Many ways to control these "birds" of the airless sky are being developed. For attack against planes, for instance, there is the "command" method. From a surface control point, the invading aircraft is spotted by radar and the missile fired. Both plane and missile then appear on the radar screen and the operator simply guides the missile close enough to the plane to let the proximity fuse in the missile explode, destroying both plane and missile.

Beam riding is another possibility. A thin radio beam will serve as a path to the attacking airplane along which the missile will go. No matter what evasive movement the target makes, the radar-radio control can nail it with this beam and, by means of computers, set the missile on an inevitable collision course.

Since ground control is somewhat limited, other methods of tracking things in the air are being worked out. Some of these involve putting radar brains in the missile itself. "Active seekers" will send out radar pulses of their own and steer themselves toward anything which returns these pulses. "Passive seekers" will steer toward any target which is making heat or light.

For surface to surface or air to surface attack at comparatively short range, television may play an important role. This type of missile will get its own information as it goes along. This may be done by radar or television scanning. The missile will "look" ahead and send back to its controller what it "sees." When it sees the target, the controller turns it downward by radio to the destructive end of its 30-mile a minute flight.

When the range is greater than a few hundred miles, the guidance and control of the missile becomes far more difficult. But not impossible. Already work is being done on magnetic navigation. Missiles guided by this system will be almost like surface ships following the magnetic lines of the earth. Perhaps even star navigation may be used by putting in the missile tiny telescopes which will locate certain stars and, by their position in the sky, give to the missile's electronic brain its position over the earth. Push button war is not a reality but it is far from being only a nightmare. No one realizes



better than the Navy's missile-men the truth of the saying that if atom-armed missiles are used in World War III, men will throw rocks at each other in World War IV.

It wasn't so very long ago that the first successful guided missiles were tested right here in the United States. In fact it was less than 10 years ago, in March, 1942. Although the Soviets will probably proclaim that they were conducting similar experiments in the days of Peter the Great, records indicate that the first successful remote controlled weapon was a U. S. Navy TG-2 radio-controlled, pilotless airplane. It was directed by television from 10 miles away, dropping its dummy torpedo "dead under" a destroyer maneuvering at 15 knots.

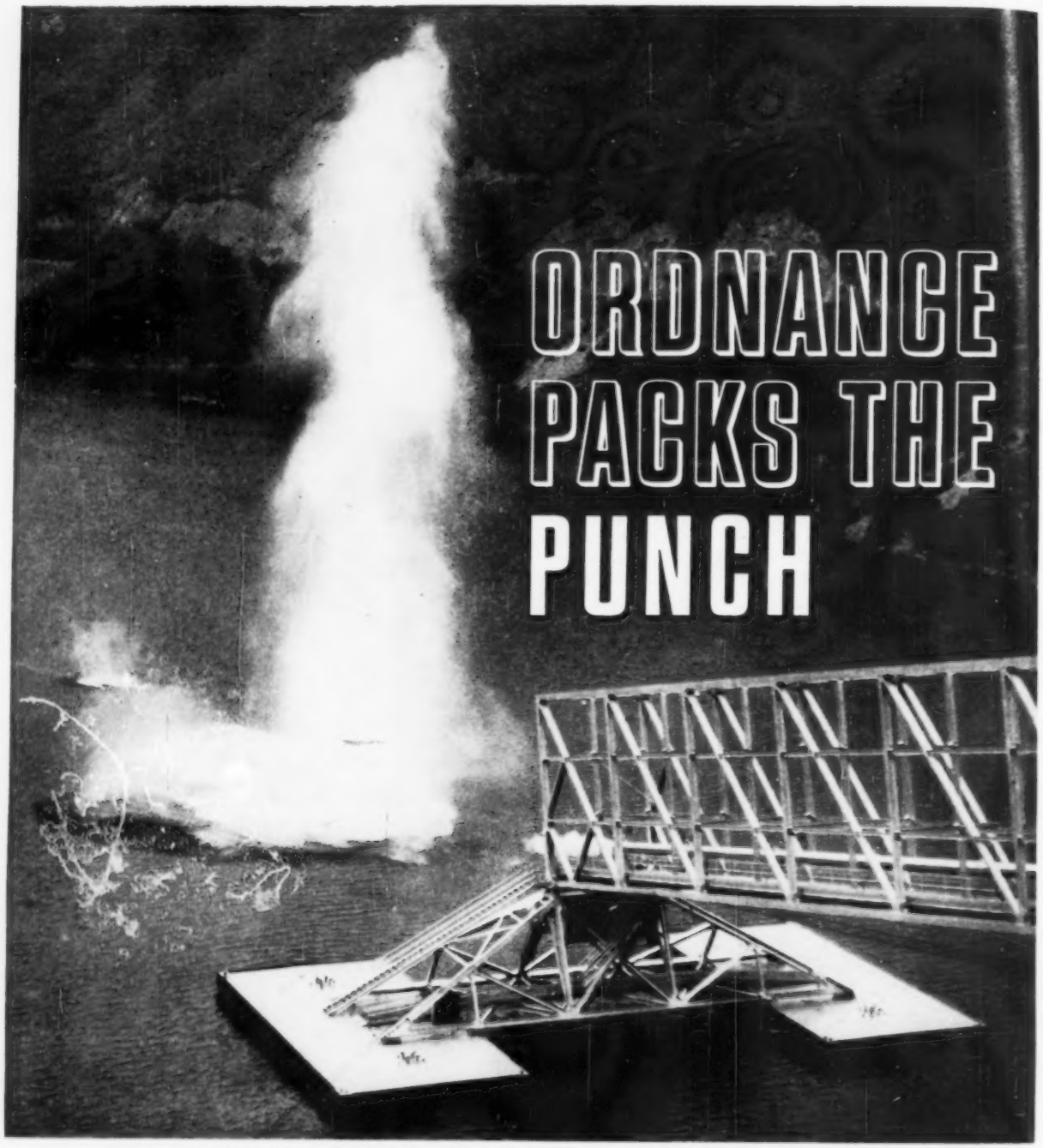
Less than a month later a BY-1 airplane, also radio-controlled and television directed, was sent crashing into a raft target towed by a tug on Chesapeake Bay at 5 knots. This was only the beginning—the stimulus which has kept Navy experimenters on the job with guided missiles ever since.

The first question that pops into a person's mind when learning about the TG-2 and the BY-1 is probably, "If they got these gadgets to working in 1942, how long had they been working to get guided missiles up to that point of success?"

The granddaddy of the guided missile is the radio-controlled, pilotless plane. The Navy started working on these 20 years prior to the TG-2 and BY-1 experiments, and actually got a radio-controlled plane, with a safety pilot aboard, into the air in 1924. Unfortunately, when it was tried without the safety pilot the plane was damaged in landing. Work con- (*Continued on page* 152)

Early model buzz-bomb with JATO is launched by USS Cusk, proving that missiles can be guided by submarines near enemy shores.

ORDNANCE PACKS THE PUNCH



Compressed air propels missiles out of 300-foot launching tube so that water-entry behavior can be studied by NOTS scientists.

THE TASK of developing a rocket capable of stopping the Russian-made T34 tanks was suddenly given to the U. S. Naval Ordnance experts. Top scientists and engineers who make up the Navy-civilian team studied the problem. The situation was critical and something had to be done in a hurry.

Almost immediately, their thoughts began converging on a peculiar explosive reaction known to scientists as the "Monroe effect." This theory—that cavities in high explosives form a jet effect of vast pressure—had been known for some sixty years. However, little consideration had been given to its application until World War II when it was first effectively used in the "Bazooka."

Under the pressures of the Korean emergency the idea was dusted off and put to fresh, untiring analysis by the Naval ordnance experts and scientists at the Naval Ordnance Test Station. Tests proved that these cavities, if lined with metal, would be focussed by the blast to form a fire and metal jet stream of terrific penetrating power. Called the "Shapped Charge," it possessed enough power to pierce the thickest plate of armor known to be used on tanks today. It will rip its way through more than a foot of Grade A steel to spew a stream of fire and molten metal inside the enemy armor.

That this new rocket was more than a match for the T-34 is now a matter of history. It was nicknamed the "RAM" for its punch power and for the speed with which it was "rammed" through development, test and produc-

NOTS devises greater wallops so fewer planes are needed for the knock-out.

tion. Mounted on Navy aircraft, the "RAM" went into action in early September and racked up a deadly efficient record.

It took only 29 days from the time this weapon was put on the drafting board until it was delivered to the front in Korea. This feat was accomplished through the combined efforts of the Navy-civilian team working around the clock at the Naval Ordnance Test Station.

"NOTS," as this station has become known, is one of the major ordnance research centers of the world, located in the Mojave Desert about 160 miles north of Los Angeles. The reservation spreads over 1,000 square miles of desert and mountain land that is free from prying eyes. This unpopulated land, encircled by mountains, is ideal for the launching of guided missiles and other ordnance.

NOTS was officially established in November 1943, with the mission of research, development and testing of rockets and guided missiles, together with providing primary training in the use of those weapons.

Then began a vast construction program. Test ranges, temporary laboratories, and other structures needed for the research were hurriedly erected. The development and testing of rockets, propellants, and launchers began under the guidance of the California Institute of Technology.

Later it was decided that the station should become a permanent, highly developed facility of the Navy Department's Bureau of Ordnance. So that the isolated site might be used to the best advantage, the Navy created a city to house the thousands of scientists, military personnel, carperters, engineers, clerks, and workers of many other kinds whose skills are needed.

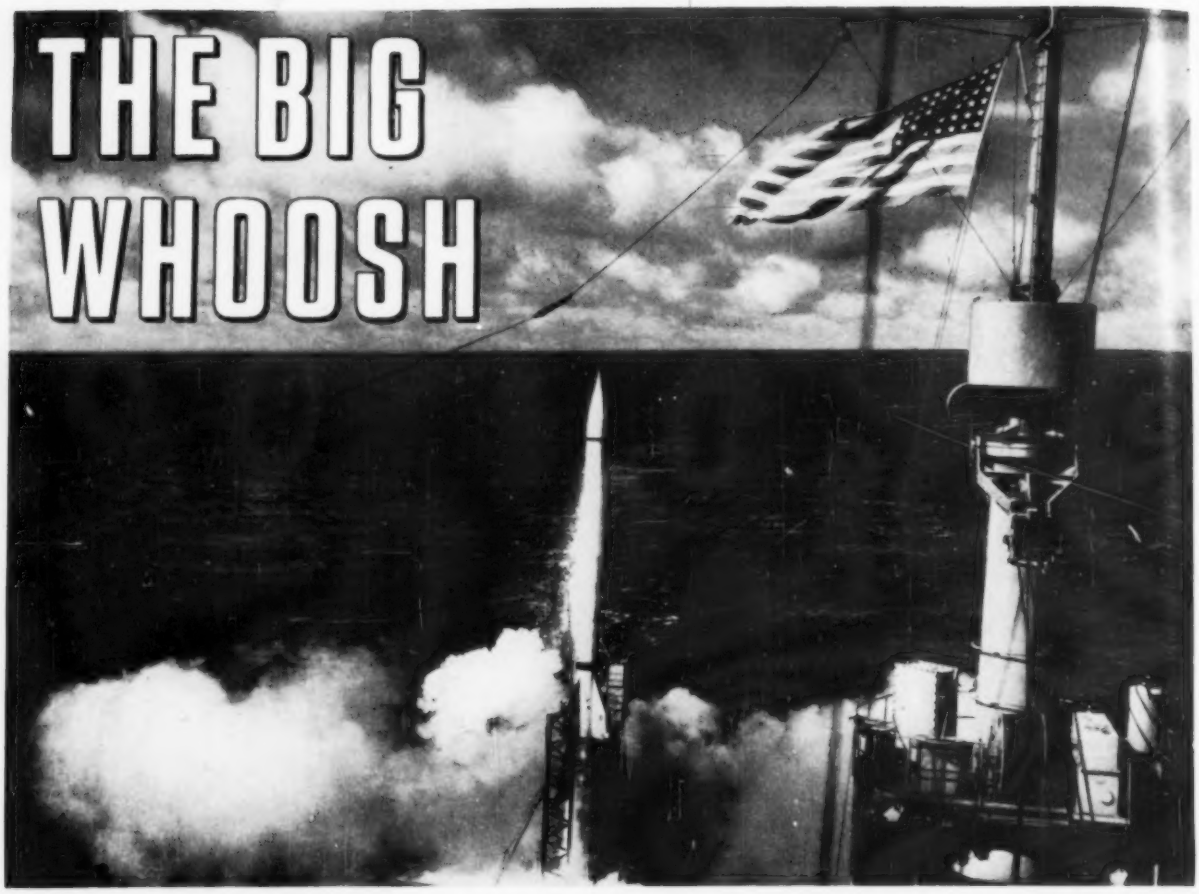
In 1945, the station took over most of the Caltech projects. The valley hummed with activity as wide-eaved homes, schools, a shopping center, the laboratory, and other permanent buildings rose to transform a desert testing outpost into a neat, attractive community.

The research center of the station is contained in Michelson Laboratory, one of the largest and best-equipped buildings of its kind in the world. Dedicated May 1948, the laboratory was built at a cost of $8,000,000. The structure is made up of sixteen monolithic concrete units, joined in such a way as (*Continued on page* 162)

Tail hook of F8F snags wire and plane comes to a stop on carrier flight deck at Naval Ordnance Test Station, Inyokern, Calif.

The 11.75 inch "Tiny Tim" aircraft rocket, launched by a Navy fighter, makes contact with target on firing range at Inyokern.

THE BIG WHOOSH



The Martin-built Viking rocket, which a few weeks ago soared to an altitude of 135 miles and reached a speed of 4,100 m.p.h. Previous record for altitude was 114 miles made by a V-2 fired from White Sands, N. M. The Viking is a single-stage rocket.

FOR CENTURIES the demand for oxygen by all engines forced man's dream of breaking out of the air layer of the earth to remain a dream. The development of the rocket engine, which carries with it all it needs to push, has, at last, turned the dream into reality. The rocket engine with its liquid fuel not only licked the oxygen problem but provided enormous power in a comparatively small package. Power enough, for instance, to shove several tons through the earth's layer of air and beyond into the airless vacuum of interplanetary space.

The Navy rockets—like the Martin made Viking—have already gone more than 100 miles above the earth at speeds above 2,000 mph. The Martin Company confidently expects its new Vikings to penetrate 200 miles into the cheerless space at speeds close to 100 miles a minute (which would amount to a round trip between New York and San Francisco in about an hour. Or 41½ hours to the moon).

Since a rocket motor takes a little while to get going, most rockets are started on their weird flights by a booster which is nothing more than a slow burning explosive which fires the rocket at a speed high enough to enable the small control fins to grip the air and stabilize the rocket. When the rocket has been steadied on its course the burned out booster drops off and the rocket motor takes over with a roar and scream which are almost unearthly.

Since the rocket engine must operate without an outside source of oxygen much of its fuel capacity is taken up by an oxidizer (usually fuming nitric acid) which, when mixed with gasoline, alcohol or aniline, produces the flaming jet which literally shoves the rocket away. Another type of power being intensively studied by the Navy is the ram-jet engine. The advantage of this engine is that it does not waste fuel space by carrying an oxidizer; instead it gulps oxygen through its gaping throat to mix with gasoline or kerosene to produce the big push. Since the ram-jet powered missile must stay inside the atmosphere (around 70,000 feet) its straight up flight is limited, but great hopes are held for its ability to fly fast and far within the atmosphere.

Two disadvantages of ram-jet power have not yet been licked although much research is being done on them. The ram-jet has no initial get up and go so that the missile must be started on its flight either by firing it or launching it from a fast airplane. Also the huge amount of oxygen needed for efficient ram-jet operation means that supersonic speeds must be reached before enough oxygen is crushed through the engine's throat to get it into really high gear. However, once started it develops enormous power—in the 100,000 lbs. of thrust class.

Rocket propulsion has given the Navy the key to the long-locked door of supersonic speed and flight beyond the enveloping cloak of the earth. Now that the door is open the giant strides of Navy missiles have just begun.

Though the Navy is just getting its foot in the door, civilization has been standing on the threshold of rocket development ever since Genghis Khan's conquests.

That old warrior Genghis Khan never heard of rockets, but his son, Ogdai, did—with a *bang*, too. According to

Rocket propulsion has given the Navy the key to the door beyond which lies the world of supersonic speed and of travel outside the earth's atmosphere.

usually reliable sources, young Ogdai was raising his own particular brand of hell with a South China city back in 1232 when the defenders let him have a broadside of rockets right into his figurative face. Apparently this blast didn't have the desired effect because Ogdai moved into town anyway.

History shows us that Italians, Arabs, 18th century Indian Princes, and even 19th century Britains tried out rockets once in a while to heckle their enemies. But it wasn't until the Germans came out with their World War II buzz-bombs and their ME-163 rocket driven fighter plane that average Mr. John Q. Public in America realized that rocket propulsion was more than something he read about in pulp fiction magazines.

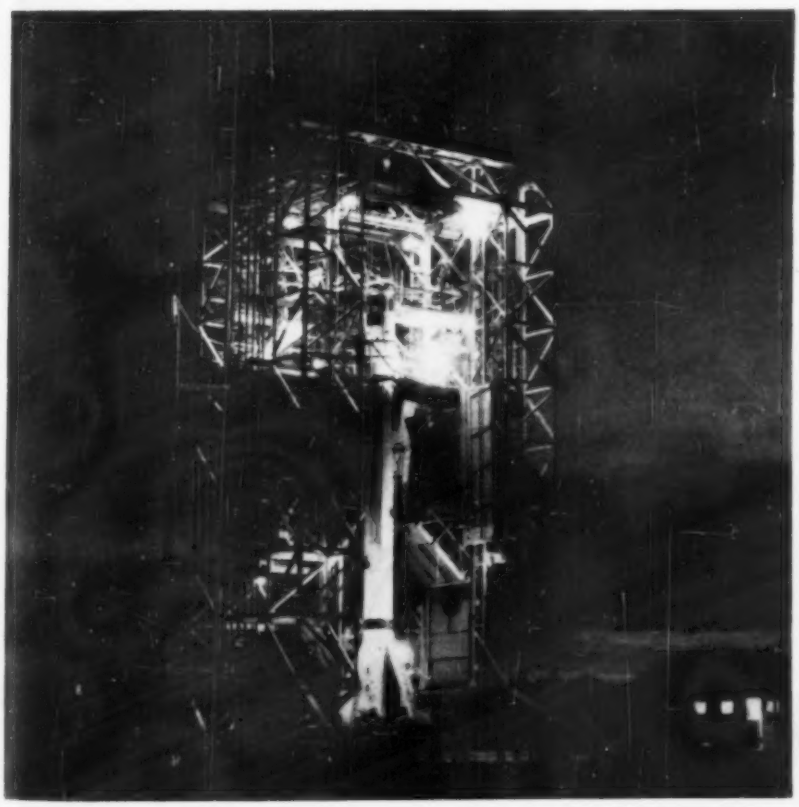
Mr. John Q. thought rockets were something that the most imaginative of budding writers used to take his readers on a trip to the moon. A rocket trip to the moon *might* be possible some day but right now, in 1951, rocket power moves planes like the X-1, first American plane to pierce the sonic barrier, and the D-558 Skyrocket.

Soon rocket motors will become standard production items of America's aircraft industry. Planes patterned after the X-1 and the D-558 will no longer be in the experimental stage, but will be aboard our aircraft carriers and air stations and will appear wherever the strong arm of Naval Aviation is required.

The Navy is interested in standardization, evaluation and acceptance testing of rocket engines required for tomorrow, just as it is interested in the piston and jet engines of today. One of the key spots in this interest is the Naval Air Rocket Test Station (NARTS) at Lake Denmark, Dover, N. J., a field agency of the Bureau of Aeronautics engaged in rocket propulsion experiments.

On the site of an old Naval Ammunition Depot, which once housed Civil War surplus cannon balls, NARTS has been in existence a little over a year. The old ammunition depot at Lake Denmark was ideal for the new job of rocket propulsion experimentation. Many facilities were already available, it had an isolated location necessary for rocket test work, and was near to all East Coast rocket manufacturers. Lake Denmark filled the bill like the size 34 sweater girl fills her size 32 sweater.

The Navy built its Rocket Test Station as a matter of simple economics. Rocket test and evaluation costs a lot ot dough, re, me. Without one government agency having different sizes of test facilities (*Continued on page* 129)



Work on the Viking continues throughout the night under brilliant floodlights which almost outshine the New Mexico moon. At right, a bird's-eye view of the 48-foot, 5½-ton missile shortly before its record flight. It is powered by liquid oxygen and alcohol.

Material Center is triple-threat task force; factory, laboratory and test station.

MAKE IT MATERIALIZE

Personnel at the Naval Air Material Center prepare for a seat ejection test jump, using specially-constructed steel tower.

NEW ENGLAND YANKEES know that Old Man Winter can almost freeze the eyeballs off a snowshoe rabbit around their part of the country. Perhaps the one spot in all New England with the highest rabbit eyeball casualty rate is the top of Mt. Washington, N. H. Necessity, overruling the Navy man's natural preference for tropic seas over icy mountains, put the Navy atop Prospect Summit.

Here to the discordant symphony of sub-zero winds and the roar of jet engines, Navy men gone-mountain-climbing, test aircraft engines for reaction under Arctic conditions. Prospect Summit tests have licked in three years the problems of gas turbine engine icing and anti-icing comparable to 15 years' progress in wing anti-icing.

The men in the long handled drawers on Mt. Washington are part of the three pronged task force of the Naval Air Materiel Center (NAMC), Philadelphia. Naval Air Materiel Center is the title covering, "Naval Aircraft Factory, Naval Air Experimental Station, and Naval Auxiliary Air Station, Mustin Field."

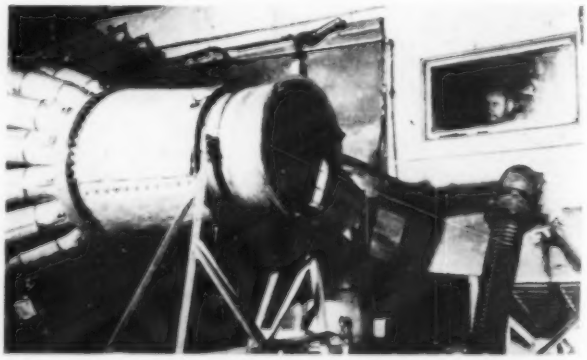
To keep Naval Aviation operating and advancing, NAMC does everything from designing a new carrier catapult or front line film delivery shell, to flying a needed arresting gear part to the fleet.

The Naval Aircraft Factory of NAMC does just what you'd expect a factory to do—engineering and manufacturing. While they don't build planes any more, they do modify and make special configurations on some. Since World War II their efforts have been concentrated on catapult, arresting gear and crash barrier development and design; structural redesign of service type planes for JATO (jet assisted take-off) installations, radomes, aerial cameras, pilot ejection seats, arresting hooks, and armament; and work in the general field of supersonics.

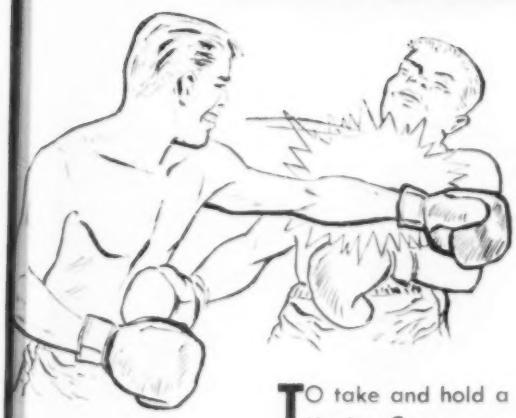
From this potpourri of skyboy talk even a low grade genius might conclude that when better Navy flying is done, the Naval Aircraft Factory will have had a hand in it.

If one of the Mt. Washington boys could be coaxed away from his test frame long enough, after chipping the icicles off his nose he'd likely allow as to how he was part of the Naval Air Experimental (*Continued on page* 178)

When flaps open on film delivery shell, loaded on fighter plane bomb racks, important pictures are parachuted to headquarters.



Engineer looks into room equipped with controls and gages which study reaction of engine being put through cold tests.



The Inside Punch!

TO take and hold a beachhead—the Marine Corps way—requires the utmost coordination between forces afloat, Leathernecks on the ground and in the air. After the initial landing, Marine ground troops sometimes run into obstacles that are pretty tough to crack. That's when the call goes out for *close air support* . . . and the specialized training of Marine aviation enters the fight. Marine pilots, flying fast and low, deliver a terrific punch where it hurts most . . . right in the enemy's front lines, accurately pin-pointed.

Mission accomplished and resistance removed, Marine ground troops again move forward.

The art of *close air support* was pioneered and developed to a high degree of efficiency by the Marine Corps during the '20s and '30s and used successfully during World War II. Today, Marine aviation is more than ever an integral part of the famous Marine land, sea and air team.

Close air support . . . the Marines' own "inside punch."

U. S. MARINE CORPS

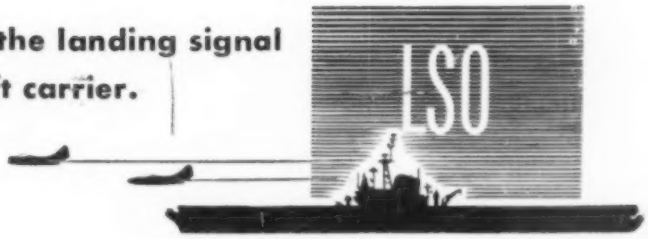
The Marine Corps has openings on its land, sea and air team. See your Marine Recruiter now.

Tigercats on the Prowl

Marine Tigercats carry a pilot and a crew of one and are used for night interception and photo reconnaissance work in Marine training.

The Landing Signal Officer directs an approaching jet fighter toward the deck of the U.S.S. Franklin D. Roosevelt. Below, Plane Director takes over after the landing and leads the plane to the hangar deck.

Symbolizing safe and happy landings, the landing signal officer is the "traffic cop" of the aircraft carrier.



PADDLE WAVER

The Landing Signal Officer's job is just one of the thousands of jobs that men do in Naval Aviation. By singling out the LSO for inclusion here we don't mean to overlook the plane handlers, mechanics, armorers, or the many others that make up the carrier aviation team. But we believe that the man who "brings them aboard" the decks of the flat-tops of the fleet is synonymous with Naval Aviation. You've seen pictures of the man with the paddles. Here you'll learn who he is, what he does, and what those waving paddles mean.—THE EDITORS.

IT WAS MARCH, but still bitterly cold in the Gulf of Alaska. Yet sweat was running down inside the LSO's gloves.

Standing on his platform aft and portside on the aircraft carrier's flight deck, the LSO chain-smoked wishing he were in any other place.

He had operated successfully as an LSO all over the Pacific but this was his first crack at waving Jet fighters aboard. He remembered what the captain told him when he first came aboard, "In this job there is no substitute for experience."

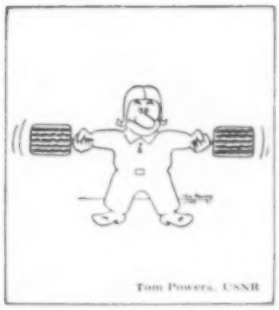
How good would he be at landing jets? The pilots were OK; they'd done it before, so he had no worries there. But what about himself?

Wishing he were among those observing the operations and not directing them, he watched the two jet fighters come over the horizon. As the carrier turned into the wind the Air Officer passed the word over the bull horn, "White flag, land aircraft."

The jets were already in the landing pattern and about to come aboard. The first came into the groove. The LSO signalled "Cut!" The fighter plopped easily into the arresting wires. The second followed with the same ease.

The paddle waver took off his gloves and wiped the sweat from his forehead. With a sigh of relief he said to his talker, "They're easier to bring aboard than prop-planes!"

Two weeks later he had acquired his experience—jets were no longer a problem. After watching four night fighters launched at 1730, the LSO went below to the wardroom for dinner. The weather was nearly perfect—almost CAVU (ceiling and visibility unlimited). But he was rudely jolted when the Flight Deck Officer called an hour later to say that they had run into foul weather and he'd (*Continued on page* 148)

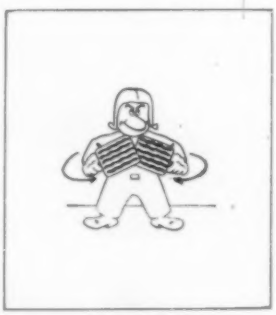


ROGER

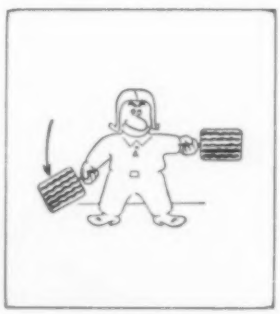
CUT

WAVE-OFF

TOO HIGH

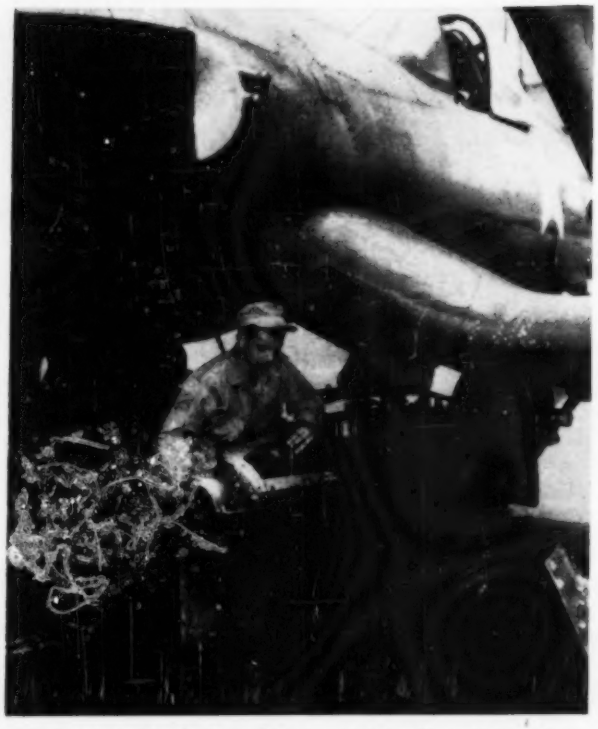


TOO SLOW



TOO FAST

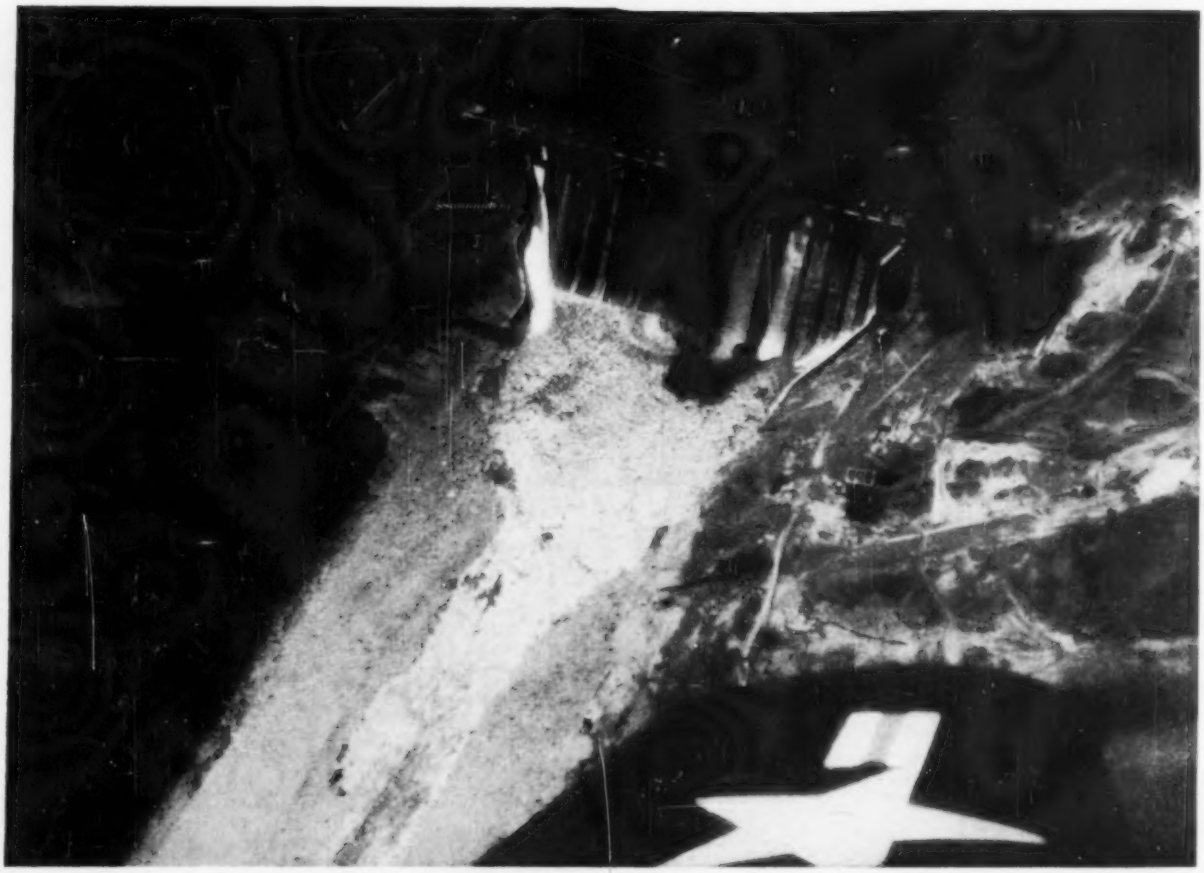
TOO LOW



Pod perfected by the Second Marine Air Wing Photo Unit carries a K-17 camera. Shell enables lens to shoot along line of fire.

WINGS, GUTS, and a LENS

A naval air photographer is a guy with plenty of what it takes to take a snapshot of the enemy right where he lives.



When an AD *Skyraider's* aerial torpedo demolished the Hwachon Dam a Navy photographer was there to record the extent of the damage.

LEUTENANT C. C. SHIRLEY is an expert on Naval Air Photography—and Leopard Seals. A veteran of 23 years of camera-pushing, Lieutenant Shirley has covered a good portion of the globe with his camera, including a sizable hunk of the South Pole. On his second trip to the South Pole with Admiral Byrd in 1946, Shirley learned a lot about camera limitations in the extreme cold. He also picked up some pointers on one of the inhabitants of that region.

On this particular day, Shirley was taking a navy photographer's holiday, snapping a few pictures from a whaleboat. When he spotted a couple of spotted seals snoozing on an ice floe, he grabbed his camera and had the coxswain heave to while he leaped aboard the big ice cube.

Shirley had been briefed on leopard seals. He knew they were fast, unfriendly and armed to the fangs with fangs. However, the hardy photographer wanted a close-up for the Navy's scrap book—and anyway, the seals were sleeping and Shirley had no intention of waking them.

The landing was made without disturbing the seals' slumber. Some six paces from danger, Shirley stopped to snap his first picture. The shutter banged and the nearer seal shuddered a bit but dreamed on. The intrepid photographer took two paces forward, changed his film, reset the camera and shot number two. That shot was a real lulu. It caught the seal in the act of unsheathing his dental equipment and charging a photographer.

Lieutenant Shirley beat a hasty retreat to what should have been prepared defenses, but the boat was missing. The Coxswain had wearied of hanging on to an ice floe, had cut his engine and floated offshore while awaiting the crazy cameraman.

But let the lieutenant tell his tale in his own words: "I continued my flight around the 30 by 50 foot floe, with the leopard close behind me."

"After I made three quick circuits around the floe, with the leopard close behind, my predicament was observed from the boat."

"The chief started the engine and came by the floe under full power, following the edge of the berg. When the boat was abreast of me, I leaped in. The leopard also leaped, but didn't quite make the boat. He disappeared into the water."

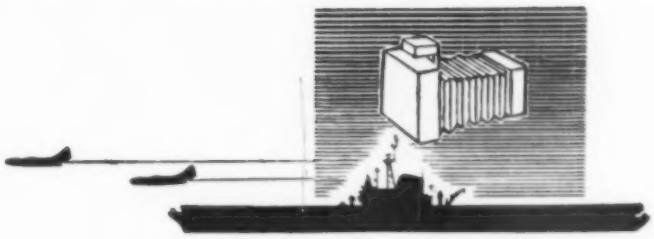
In a way, Lieutenant Shirley's experience symbolizes naval air photography. A character armed with a fast set of legs, a great deal of brass and a camera taking pictures of the foe right in his native lair. This particular shot may not add very much to the Navy's file of photographic intelligence. On the other hand the picture he took is graphic proof that a leopard seal has some offensive equipment and is a belligerent sort of individual—not a good playmate.

Photo intelligence does a similar job, it tells the combat forces what to expect and where. These photos are obtained right in the enemy's backyard by photographers in unarmed aircraft.

The German army had a far-sighted, as well as a ponderous-named General in Oberst, Baron Warner Von Fritsch. In November, 1938, the General said, "The nation with the best photographic intelligence will win the next war."

The General may have been correct. The Pacific phase of World War II used photography as a primary source of intelligence. In fact, the U. S. Strategic Bombing Survey points out that approximately 85 per cent of all World War II intelligence was derived from photography and photographic interpretation. It is of fundamental importance to all phases of combat.

Prior to invasion, aerial mapping flights cover the territory over which the troops will move. Recco photos show details of the production capacity of an area, of the transport and communication facilities, and of the populations' densities.



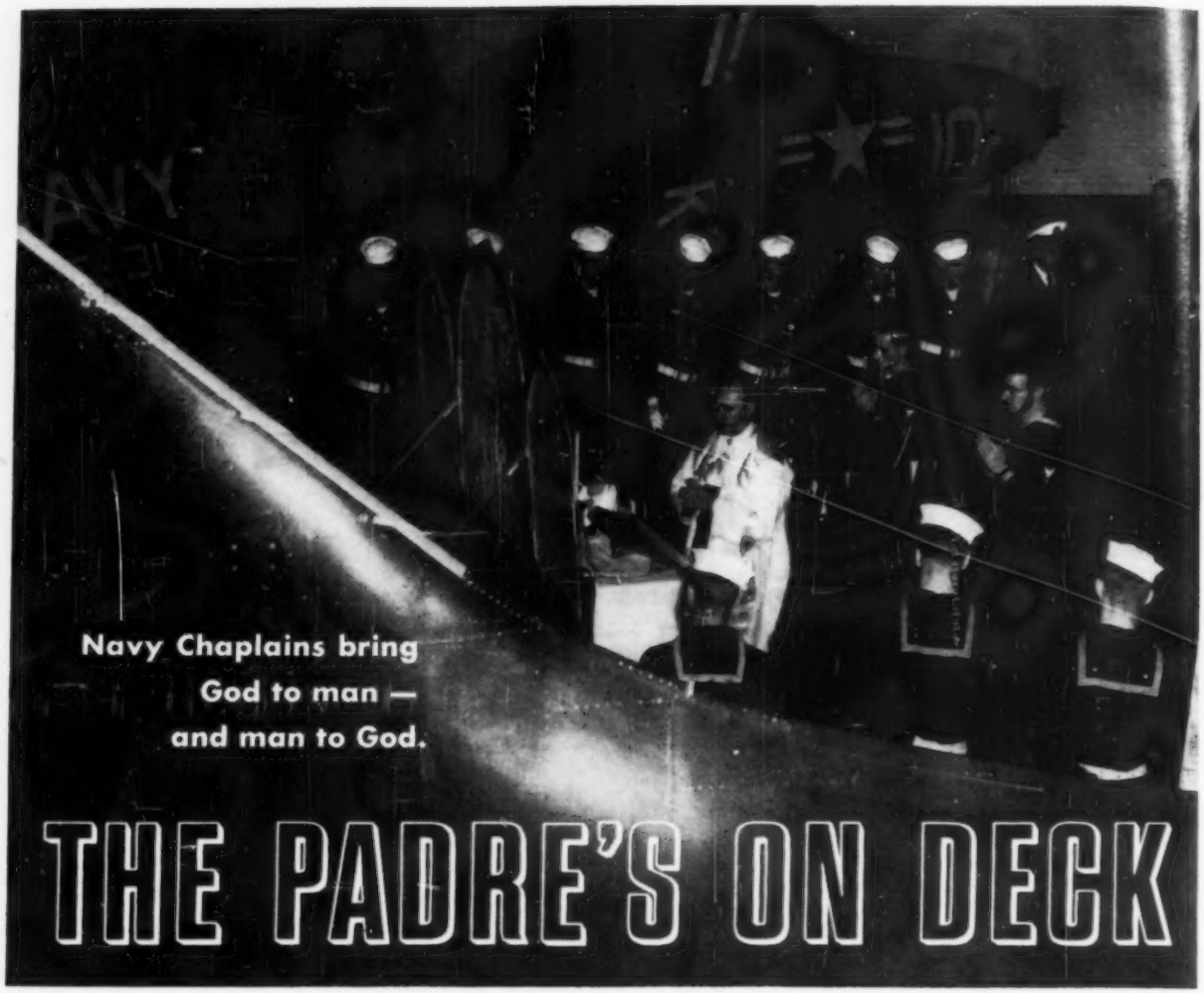
Aerial photos are made of the battle-areas and of the area behind the lines, to determine precisely the position of the enemy and his strength. These pictures show the "soft" spots for advance, for bombing approaches, and the "tough" spots, the areas to by-pass, to bomb, or bombard.

Gun cameras are carried by aircraft, not to insure the pilot's receiving credit for a kill, or to get a whale of a good shot of a plane blowing up, but rather for purposes of photo intelligence. From these shots an expert interpreter can tell an aeronautical engineer enough about "that new type jet that showed up on the northern front today" to give that gentleman all he needs to evaluate the performance of the new fighter. Also, gun camera film makes a "kill" very definite.

Pictures taken of areas which have been bombed, or specific targets which have been destroyed, aren't intended merely to keep medals coming to the pilots. They are a part of damage assessment, and will tell the headquarters planners whether to "scratch" a target off the schedule, or to re-deploy another bombing group over that area tomorrow. If the target has been destroyed, perhaps it can now be by-passed or the area occupied by our troops. For the purpose of damage assessment, carrier photograph planes fly along with the combat aircraft. In Korea, one of the first planes lost in the war was a Marine photographic plane.

The risk is great and the plane unarmed, but the information received is worth the effort involved. In early May, 1951, newspapers carried (*Continued on page* 156)

Photographer-frogman swims with submarine camera which propels itself and takes motion pictures of submerged hazards.



Navy Chaplains bring
God to man —
and man to God.

THE PADRE'S ON DECK

IT WAS SUNDAY morning in Korea.

There was a temporary lull in the fighting—NOT in deference to the Sabbath—but because the Reds had temporarily retired to lick their wounds.

The big guns of the MIGHTY MO were silent as were those of the CV's, the LEYTE, BOXER and the PHILIPPINE SEA, largest of the Navy's aircraft carriers in Korean waters.

The sound of the church call—said to be the most beautiful ever to leave a bugler's lips—echoed over the blue waters as Chaplains E. Richard Barnes, Methodist and H. E. Meade, Catholic, held non-sectarian services which were broadcast by radio to destroyers of Task Force 77 and piped over the public address systems of the smaller combatant ships which did not have chaplains aboard.

It was an unforgettable scene; the summer sun sparkling on the water; the gentle roll of the ship; the church pennant flying from the yardarm; the chaplains in their vestments and 1,600 men in uniform forming a semi-circle around the small altar.

Aircraft carriers based in enemy waters generally hold divine services below on the hangar deck. Or the chaplains wander about the ship talking to the men at their gun stations and visiting them in the engine room and the sick bay.

On the large aircraft carriers the chaplain has his own office. He maintains a regular schedule for the benefit of the men on their off-duty hours. He advises them on family matters and consoles them in times of bereavement. Since it is important that he get to know them, he frequently joins them at mess.

"A man stationed in combat areas," said Rear Admiral Stanton W. Salisbury, Chief of Navy Chaplains, "is particularly vulnerable to bad news from home. Telegrams reading: 'Mother seriously ill, come home at once' and signed 'Sister Sue' will throw a man into a spin.

"The chaplain's job is to check the facts with the American Red Cross. If the illness is serious he may ask the skipper for the man's transportation home. Such a request is seldom refused.

"'All right! We'll get him out!' the skipper will say.

"If, as frequently happens, the illness is temporary, we are at least able to alleviate the strain and worry. You'd be surprised," he added, "at some of the things people write with no thought of the impact bad news will have on the man at the front. We are trying to educate families in writing the right kind of letters. We want them to write often, but to keep the letters cheerful."

Pilots stationed aboard carriers in combat areas seldom have time for organized prayer before a take-off. However, if a mission is particularly hazardous, the chaplain offers short prayers. (*Continued on page* 145)

20 Techs

(*Continued from page 78*)

ing, fuel, cooling, hydraulic and electric systems and propellers, too, became as familiar to Dave as the face of the kid next door in Euclid.

Navy mechs have to be proficient as plane captains. At NATTC Memphis Dave Aitken learned flight line operations, safety precautions, and how to perform periodic maintenance checks, engine changes and trouble shooting. He got a thorough workout on jets, too, from theory to actual starts, runups and stops of jet engines on the line.

Now Dave has completed his intensified course at the Aviation Machinist's Mate School and is ready to put to use what he's learned. "After my leave in Euclid, I'd like to get assigned to the Naval Air Test Center at NAS Patuxent River, Md., where I can get experience on the very latest planes," says Dave. "Then I'd like to go to a patrol squadron for duty as a flight engineer." His chances for getting what he wants are good.

When Lieut. (jg) Wallace E. Sharp, USN, graduated from Naval Air Technical Training's Aviation Electronics Officer's School at NATTC Memphis, the Navy got a new qualified electronics officer and Wally added to his already liberal aviation education. Unlike Airman Aitken, Wally is an old hand in Naval Aviation. After pinning on his gold wings at Pensacola in January '45, he flew PV *Ventura* patrol bombers in the Pacific and then put in a tour of duty with a fleet air service squadron at Miramar, Calif. After completing the Navy's General Line School at Newport, R. I., he went back to Pensacola as a flight instructor for a year and a half before reporting to NATTC Memphis.

"Before I came to Memphis, I didn't know a thing about electronics," said Wally. "But now I feel competent to set up, operate and supervise any electronics shop in the Navy, and furthermore, I can repair my own car radio when it goes on the fritz!"

Officially the Aviation Electronics Officer's School is simply "to provide selected Naval Aviators with knowledge to make them competent electronics officers." In a brief 30 weeks, these officer students take a full two-year course in radio, radar and shop administration. A combination of learn-by-doing and classroom work makes this possible, and is typical of the training methods in all the Naval Air Technical Training Command schools.

Wally's first two weeks at the school were booked solid with lectures in basic electricity and electronics. He next was introduced to superheterodyne radio receivers and practical receiver circuit analysis in the classroom which was followed up by building a complete five tube radio in the laboratory. He got the same treatment with amplitude-modulated radio transmitters complicated by the instructors inserting "bugs" in both sets for Wally's analysis and correction!

"After basic radio we studied and analyzed aircraft motors, generators and electrical circuits," Lieutenant Sharp reported. "Then we were instructed in trouble shooting on several typical service type aircraft radio receivers and transmitters. Later we learned the workings of synchro systems and automatic radio compasses, VHF and UHF electronics equipment, and radio altimeters.

"That was only the beginning, because we dug into the theory, operation and maintenance of radar and other pulse-type gear. We learned about pulse circuits, basic radar theory, aircraft radar and test equipment, radar countermeasures, and construction of special radar circuits."

Future electronics officers learn the meaning of the word *logistics*, too! They receive thorough indoctrination in the electronics supply system, squadron material and electronics officer functions, allowance lists, official publications, procurement and care and custody of material, allotments and surveys. In a final move to complete the picture, they learn management problems, personnel relationships, training subordinates and methods of job improvement.

"I'm on my way to the West Coast now," relates Wally. "I am anxious to put into practice the things that I have learned. Although I still have plenty to learn, I feel confident about taking over an electronics maintenance job."

Only two schools have been dealt with here, but the training principles utilized in them are similar to those used in the thirty-odd other schools of the Naval Air Technical Training Command. Five levels of training are conducted by the command: Preparatory, Basic, Advanced, Specialized, and Officer. In addition to the ones mentioned, separate schools are in operation to train aerographers, air controlmen, aviation boatswains, aviation electricians, aviation electronics technicians and electronicsmen, aviation ordnancemen, photographers, aviation storekeepers, aviation structural mechanics, parachute riggers, training devices technicians, ground controlled approach operators and technicians, pilotless aircraft operators, catapult and arresting gear operators and maintenance personnel, instructors and supervisors, fire-fighters, aircraft instrument maintenance personnel, helicopter maintenance personnel, aviation supply officers, combat information center officers, and photo and photo reconnaissance officers.

This is a lengthy and impressive list, but it is no more impressive than the mission of the Naval Air Technical Training Command. As stated by Rear Adm. Johnson, "Our mission is to assist the forces afloat and ashore by supplying Naval Aviation with the finest technical training possible—training in methods of operation, of maintenance and repair, and in utilization of equipment peculiar to Naval Aviation."

Tech Training has carried the learn-by-doing method of training through the period of peacetime preparedness and up to the present day. As perfected by the command, it offers many advantages not possible in on-the-job or apprentice-type training, formerly the bulwark of Navy schooling.

Because of the time involved and the facilities available, Technical Training is ordinarily conducted at centralized locations rather than in the fleet or at other operating activities. However, in Technical Training, as in everything else, there are exceptions to a general rule. In certain specialized kinds of Technical Training, it has been found not only possible, but essential, in some cases, to have the classroom and instructors go to the trainee instead of the traditional vice versa.

This is the job of the Naval Air Mobile Trainer—to take the mountain to Mahomet or the training to the trainee! The Naval Air Mobile Trainer is a small, mobile school complete with trained instructors, the necessary mockups, cut-aways, films, and technical literature, traveling by truck from activity to activity as needed.

The value of a man in his job will gradually but inevitably decrease if he does not continually keep abreast of changes in aircraft, weapons, and equipment. Naval Air Mobile Trainers bring to already trained men who are working at their rates, the latest information on modifications and improvements—and, in addition are able to offer "refresher training."

Naval Air Technical Training, through its advanced methods of instruction and improved conception of what military training should be, has had approximately half a million men pass through its doors. Civilian schools have copied many leaves from Tech Training's book of methods.

During World War II, the needs of the fleet were basic in nature; the needs being basic, the training was basic. There was little aviation equipment available for training—and even less was available in the nature of aircraft. Even in the late stages of the war when more modern planes became available, the training remained basic.

Naval Air Technical Training is still a basic proposition—but the word "basic" has a new and different meaning. While tomorrow's planes are not available for training purposes, modern planes are. The trainees learn what to do and how to do it. They learn how to maintain and operate some of the same equipment that is found in the fleet. As fast as new equipment becomes available for training, it is put into the classrooms and shops. Instructors are specially trained in the latest methods of instruction. Provided with the latest available equipment, instruction is conducted at a high level; so that training today is "advanced" in concept though remaining "basic" in nature. All graduates of Technical Training schools are ready to assume their responsibilities at an instant's notice.

Naval Air Technical Training believes that it provides the best technical training in the world. Such a standard is possible only through continual adaptation to the constantly changing needs of the fleet. Naval Air Technical Training is and must be, part of the flexibility of air-sea warfare; and to all intent and purposes is a partner of the fleet wherever it goes around the world. END

Your Business

(*Continued from page* 123)

fire which followed the crash and the pilot was killed.

In these circumstances the possibility of determining the cause of the engine failure is greatly reduced. The accident board may have little to go on except the statements of witnesses who heard the engine pop and quit and watched the pilot make the fatal mistake of wrapping the fighter up in a tight turn at low airspeed. However, even though the accident board must report this as a power failure, cause undetermined, the accident report is still of value.

In this emergency the pilot's incorrect reaction cost him his life. The accident board notes that had he but tightened his shoulder straps and made a crash landing straight ahead, he probably would have survived.

Such a report is a valuable source of material for the widely read "Grampaw Pettinbone" page of "Naval Aviation News," wherein the errors of pilots and crewmen are discussed each month by the "oldest living naval aviator." If not used there, it might well be the subject of a WRECKORD poster, or a Flight Safety bulletin.

The value of having all the aircraft accident records available for study in a central office is clearly illustrated by the following example. During one six-month period shortly after the war the Navy was operating two types of fighters which were available in large numbers. Both were flown about the same number of hours during this period. In one type, there were 51 fatal accidents, while in the other there were only 19 fatal accidents. A study of the cause factors in these accidents showed that the significant difference lay in the number of spin and stall accidents. One plane had the desirable characteristic of giving a warning shudder prior to the stall, while the other had a tendency to snap to the left without warning. From a cold statistical standpoint a pilot's chance of being alive at the end of the six-month period appeared to be about three times as great were he assigned to one type as against the other. Both planes were employed extensively in carrier operations where it is necessary to approach the stalling speed of the aircraft at low altitudes during the landing phase.

A Navy-wide campaign was started to acquaint pilots with the "facts of life" pertaining to this particular aircraft, which except for this undesirable characteristic had proved to be a very fine high performance fighter with an impressive combat record during the last year of the war. Pilots were warned in posters and articles. Experienced pilots were prohibited from flying this model until they had accumulated 100 hours in other fighter types. Meanwhile attempts were made to develop a satisfactory stall warning device which would introduce artificially the same shaking of the stick which warned pilot in the other type of impending stall.

The pilots were exposed to a liberal amount of rather gory reading material relative to spin and stall accidents that had occurred in this type. Forewarned is forearmed, and the success of this safety campaign was quickly demonstrated. During the next six-month period the number of fatal accidents in this type dropped by over 60 per cent.

During this period accident reports indicated that a number of pilots had bailed out of this type following failure to recover from inverted spins. Earlier flight tests which had indicated that the plane would not go into an inverted spin were evidently incorrect. The accidents showed that the plane would go into an inverted spin at high power settings such as those used during an Immelman turn. Subsequent test flights showed that recovery from the inverted spin was difficult, if not impossible, unless the throttle was retarded.

This word was passed and the number of unsuccessful recoveries from inverted spins was quickly cut. Of course, there is always someone who doesn't get the word, despite the number of safety articles and technical notes that are prepared on any subject. During this particular safety campaign one pilot spun inverted from 22,000 feet to about 8,000 feet where he decided to give up and get out. Just before unlocking his safety belt, he pulled the throttle back.

You guessed it! The pilot was no sooner clear of the plane than it righted itself and set up a glide for the home field. It crashed in an almost level flight attitude on the runway which ran parallel to the line of hangars.

"Are we getting safer?" is a question that is frequently asked of the Flight Safety branch. It is not an easy question to answer, for the Navy's safety record is measured in many ways.

Accident rates for the Navy are most commonly expressed in terms of so many accidents per 10,000 flight hours. Sometimes the rate is expressed in terms of the number of accidents per 1,000 field or carrier landings. Accident rates thus expressed have been going down for the past five years. Particular progress has been made in reducing the fatal accident rate, and this is surprising because actually the average accident is more serious than it used to be.

Before the war only 17 per cent of all major damage accidents resulted in "strike" damage to the aircraft. At the present time nearly 35 per cent of all major accidents are ones in which the plane is so badly damaged as to be beyond repair. The higher percentage of "strikes," is a natural result of the increased performance of present-day aircraft. Planes that are faster, heavier, and carry higher wing loadings just naturally have greater impact speeds when they crash.

The fact that the percentage of injuries and fatalities is going down while the seriousness of the average accident is on the rise is a tribute to the advances that have been made in pilot protection. The planes being procured today for the Navy have a tremendous amount of protection built into the airframe. Pilot's seats in carrier type aircraft are stressed to stay in place in impact forces of up to 40 "G." In addition cockpit structures are stronger and overturn structures are designed to protect the pilot from injury in the event the plane flips over on its back in a landing.

Improvements are constantly being made to personal protective equipment. The new type crash helmet which is being procured in large numbers is a real life saver. Work is progressing on a more satisfactory type of exposure suit.

In terms of monetary costs, the aircraft accident picture is far less encouraging. The annual cost of Navy aircraft accidents has gone up rapidly in the past few years. The principal reason for this is the increased cost of planes and the equipment which they carry. Some carrier type planes today carry electronic equipment which costs more than we paid for a fully equipped attack or fighter plane during the last war.

Accident cause studies continue to show that pilot error is the most frequent primary or contributory cause factor. Pilot errors are involved in 65 to 70 per cent of all accidents. The remaining 30 to 35 per cent are divided between accidents assigned to material failure or errors of other personnel such as tower operators, weather forecasters, and others. END

Bombs, Bullets

(*Continued from page* 119)

raised many complications for the armament designers. Although it cannot be said that there were any traces of complacency with naval aviation armament in 1944-45, matters were apparently under control for the moment. Our losses were low. Our ability to inflict damage was high. But danger signs were cropping up.

The jet airplane is fast. It climbs high—and as it reaches high altitudes it finds itself in well below freezing temperatures—even though it may be warm on the ground. Visibility to the surface is poor and two fast jets passing each other or even flying on parallel courses at high altitude have trouble seeing each other. At night it is impossible, with the naked eye, to find another airplane flying at high speed and altitude.

Because of these characteristics of the jet airplane and the resulting conditions of combat—the pilots began to encounter numerous operating difficulties.

Perhaps the most provocative current problem is, that the very fast jet fighter, when flying in the rarefied air at high altitudes—say 50,000 feet—cannot develop enough lift to permit more than a 2 to 3G turn. Putting it another way, the fast jet fighter flying at high altitude must make very large radius turns. The geometry of the situation of a fast jet attacking a fast bomber at high altitude thus results in the fighter always flying up the tail of the bomber before an effective firing range is reached.

From the fighter's point of view, the tail cone of the bomber is a very un-

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Navy Lifts Its Share

(*Continued from page* 103)

over routes of mutual interest to the three services. The contribution of the Navy to MATS is directly proportional to the airlift received by the Navy over those routes of mutual interest. The airlift for direct fleet support required for the fulfillment of the mission of the Navy over routes of sole interest to the Navy, or where the requirements cannot be met by MATS is provided by the Fleet Logistic Air Wings as provided for by law. The Navy has two 12-plane and one 15-plane squadrons in MATS currently operating R5D or DC-4 type aircraft.

Navy is a junior partner in MATS, making up approximately 10 per cent of the operational organization of the command. Three 1,000-man, 12-plane Navy Squadrons are attached to MATS. One squadron (VR-6) is stationed with the Atlantic Division of MATS at Westover, Mass. Naval Air Transport Squadron Three is located with the Continental Division at Moffett Naval Air Station. Naval Air Transport squadron EIGHT, of Airlift fame, is still doing business in the same old way at Hickam AFB in Hawaii. The Atlantic and Continental divisions are under the command of Air Force Generals, with the Pacific division being commanded by Rear Admiral John Hoskins, the peg-legged Admiral who commanded the first United Nations forces to hit Korea after the war began.

Even though the Navy comprises the shorter slice of the MATS pie, they are still delivering the goods in top form. Under the direction of hard-hitting Rear Admiral Hugh H. Goodwin, Lieut. General Lawrence S. Kuter's Vice-Commander and Senior Naval Officer, MATS, the Navy continues to carry their share of the load plus.

Speed and time are two of the most precious commodities of any war. And these are the items which air transportation peddles. When limited logistic support is needed fast to provide time for reinforcements and additional logistic support to arrive, air transport is the answer. The "heavyweights" of transportation—trains, trucks, ships—still must carry the mass of materials needed to fight a war. In the Korean effort, perhaps 40,000 tons of cargo have been flown to Japan from the US during the first year of war. This amount of cargo has been flown by a minimum of 100 MATS aircraft, 60 commercial aircraft under Air Force contract, two squadrons of aircraft of other United Nations and a considerable number of Navy and Marine Corps aircraft, not assigned to MATS but helping in a pinch. During the same period the Navy's Military Sea Transportation Service delivered more than 60 times this 40,000 ton figure in *aviation fuels* alone. Without aviation fuels delivered by surface ship, even the tremendous cargo delivered by air would have been entirely impossible.

Nonetheless, the job that air transportation has done in its field cannot be reckoned in standard terms of value. Air evacuation of wounded in Korea has helped cut losses of wounded by half the World War II figure. Without the immediate delivery of items critically needed, such as anti-tank rockets to stop the Korean armor, blood plasma to keep wounded soldiers living, ammunition when ammunition was short, carburetors when carburetors were short, not only would additional lives have been lost, but battles might have been lost—perhaps a war. So let it be understood that air transportation serves a tremendous purpose, even though it has delivered less than 5 per cent of the total logistic requirements of the continuing Korean campaign.

During May 1950, the month prior to the kickoff in Korea, less than 70 tons of cargo was delivered by MATS to Japan. In the month of August, one month following Korea, VR-6, a member of the Atlantic division, alone supported the Pacific airlift by hauling more than 70 tons of material from the East Coast of the US to Japan. Utilization figures of the Navy squadrons of MATS, which were pegged at 6.0 hours per day pre-Korea, rapidly climbed to 9.0 hours per day under the pressure of the "police-action." These figures came back to 6.0 hours only after the requirements came down.

In addition to the direct air transport support provided by the Navy components of MATS to the Pacific airlift, some 16 Navy pilots from VR-6 were siphoned into Air Force MATS units in the Pacific to act as navigators. This was done to alleviate a critical shortage of Air Force navigators. Although it was an unusual occurrence, the fact that Navy pilots were called upon in this emergency because they also are navigators, is a good example of the working relationship between the Air Force and Navy units of MATS.

While Rear Admiral William G. Tomlinson was Commander of the Pacific division he wore his tie tucked into his shirt front Air Force-fashion. His Sargeant driver answered his directions with a snappy and salty "Aye, Aye Sir." This is a homely example of the mutually cooperative spirit extant in MATS. It exemplifies the working arrangement between the two services. This spirit of cooperation and camaraderie not only works during working-hours, but it extends into the after-hours relationship. At Westover AFB, Capt. H. P. Badger was long the elected chairman of the board of the officer's club, while one of his senior Chiefs held the same position at the NCO club.

MATS gets critical items "over there" in a hurry—Naval Aviation is a part of this air transport team. END

BuAer's Goal

(*Continued from page* 67)

speeds well into the supersonic range. As flight speeds are increased further and further, the ramjet and rocket become of greater interest. At present, the major difficulty with the latter engines is the extremely high fuel consumption, which seriously limits range. However, it may be said that, at present, power plants exist which permit flight—within certain range limitations—at almost any desired speed.

It has been estimated conservatively that by 1960, operational airplanes flying at speeds of about 1,500 m.p.h. at altitudes above 50,000 feet will be entirely feasible. Under these conditions, a serious problem arises in connection with high stagnation temperatures, which will reach a value of 300° F. or more. These high temperatures are due to compression of the air as it strikes the fast moving plane, with additional heating due to friction of the air over the skin of the ship.

Even though the outside air is very cold (about —67° F.) it cannot be brought in to cool the aircraft because it will rise to these same temperatures in the process. This temperature increase will not only necessitate increased structural weight, but will also introduce weight penalties in the form of large refrigeration units for cooling the crew, communications equipment, instruments, engine accessories, batterics, tires, etc. The ingenious application of compressed air turbines to provide this refrigeration is discussed elsewhere in this Naval air power issue.

The Navy is conducting a broad experimental program both in its own laboratories and through contracts with civilian organizations to develop new structural materials to withstand these high temperatures. This problem is complicated by the fact that these materials must not only be light but also strong at high temperatures and freely available. Titanium and its alloys are some of the more promising developments in this program. Since the increase in temperature depends on the square of velocity, the problems introduced by aerodynamic heating can be expected to increase rapidly as operational speeds are increased further.

Since Navy airplanes are intended primarily for carrier-based operation, the retention of satisfactory low-speed flying qualities cannot be ignored, regardless of the high speed for which the airplane is designed. Unfortunately, many of the design features dictated by high-speed considerations are not conducive to good low-speed qualities, and a considerable amount of the effort on high-speed aircraft has necessarily been concentrated toward improvement of low-speed characteristics.

One important step in this direction was taken by the Navy shortly after World War II. At this time, it was becoming evident from the results of research both in Germany and in this country that one attractive feature from the standpoint of high-speed flight would be highly swept-back wings. It was also evident that on a swept-back airplane some difficulty could be expected with stalling characteristics and stability and control near the stall. Rather than wait until a high-

speed airplane could be designed and built, the Navy had two conventional fighters fitted with swept wings. These modifications were intentionally kept simple and inexpensive, and the airplanes were therefore limited to low-speed flight. But they provided an early opportunity to study effects of sweepback in actual flight, and results permitted valuable and necessary correlation between flight behavior and measurements in the wind-tunnel measurements.

In order to facilitate flight research on transonic and supersonic aircraft, the Navy and the Air Force have provided the National Advisory Committee for Aeronautics with a number of special research airplanes including the Douglas D-558-I and D-558-II, the Bell X-1, and the Northrop X-4, and are cooperating with the NACA in the conduct of its research programs. Much valuable information has been obtained in these investigations, but much more is needed if research is to stay a large enough jump ahead of production design.

The results of this flight experience and the results of high-speed missile testing have aided in the interpretation of theoretical and model test results, thereby increasing the value of subsequent investigations. The flights to date have also been extremely useful in pointing out the areas in which the research to be conducted during the next few years can most profitably be concentrated.

Notwithstanding the optimistic note on which operational supersonic flight is being pursued, the problem of pilot and crew emergency escape from aircraft at high speed is being given considerable attention. Although ejection seats have proved adequate for escape from today's fighters, it appears obvious that the pilot and crew of an airplane flying at speeds well into the supersonic range will need considerably more protection in the event that they are forced to abandon ship. For this reason completely jettisonable nose sections have been proposed and are being investigated. Present knowledge indicates that these nose sections will have to be stabilized independently by fins in order that the large forces which might be encountered during the motions of an unstable nose section can be avoided and the possibility of injury to the crew reduced to an irreducible and absolute minimum.

From this brief view of supersonic flight possibilities, the following conclusion may be drawn: Supersonic flight on an operational basis is very definitely feasible. Before such operation can become routine, however, a great deal of research and development must be completed. The Navy is participating vigorously in this effort, not only for the immediate goal of more effective naval aviation but also for the eventual benefit of commercial aviation as well.

The final limitations on the extent of supersonic flight possibilities, if in fact such limitations do exist, cannot be estimated at the present time. When it is realized, however, that basic laboratory tests have already been directed toward conditions involving speeds 15 times the speed of sound at an altitude of 200,000 feet, the possibilities are vast and extremely staggering. END

Air Navy's Quarterback

(*Continued from page* 55)

both with the civilian and military agencies in such matters as flight rules, location of airports, safety regulations and international airways. It maintains aerological services which work closely with the Air Force and Weather Bureau to serve all those who use the air. Finally, the Flight Division seeks by instruction, education and better design of devices to improve the safety record of Naval Aviation.

From the beginning, Marine Corps pilots have been trained as Naval Aviators. Only after receiving their wings do they branch out into the specialties of the Corps. As the last war amply showed, they never forget their basic training and are available to supplement and support Naval Aviation when needed. Because they use the same types of aircraft and aeronautical equipment, there exists a Marine Aviation Division in the Office of the Deputy Chief of Naval Operations (Air). Its Chief serves as an Assistant Commandant of the Marine Corps and thereby provides close relationship between the two organizations.

A striking development of the last few years has been the expanding field of guided missiles. There may come a day when they will be as common as big guns or aircraft. They will then be integrated into the Navy system. Right now, progress is being made daily both in development and production, but much is still experimental. So long as this situation prevails, there will be a need for a guiding hand to coordinate the Navy's activities in this field and to act as representative in dealing with the other services and the Research and Development Board. A special Guided Missiles Division under the Deputy Chief of Naval Operations (Air) is charged with looking after this responsibility.

The Navy believes that its aviation program was shown to be fundamentally sound when operations in Korea put it to the test. The Navy and the country have a right to be proud of the speed with which Naval and Marine Corps aviation responded and went into action. The plane types were more than adequate; the training and doctrine effective in the support of United Nations Forces; and the ability to work with other Services and with allies gratifying in the extreme.

There are lessons to be learned! In a field of rapidly changing progress such as aviation there are always lessons to be learned. The Office of the Deputy Chief of Naval Operations (Air) is studying the experience of Korea and the technical developments of American science and engineering. On these bases new programs will be worked out to keep United States naval aviation up to the high level it has always achieved in the past. END

Envelopment

(*Continued from page* 64)

be reversed.

4. By mounting anti-tank weapons, armored attack can be repulsed or seriously hampered.

5. A force may be landed in its selected formation for the assault. The supporting arms can be properly disposed in relation to the direction of the attack.

6. The reserve is committed at any selected point, at any selected time, in any formation, and can attack anywhere.

7. The conventional forms of ground warfare such as ground security elements, approach march formation, and deployment are not necessary. The place of ground contact cannot be determined by the disposition of the enemy.

8. Logistic support comes from the air, during the second and subsequent trips of the helicopters.

9. Should displacement become desirable, the helicopters return, lift the helicopter-borne assault force, and re-land it in the desired locality.

10. There are few—if any—areas restricted to helicopter landings and even in restricted areas the helicopters can hover while loading and unloading.

11. The troop elements of helicopter-borne assault forces, when in the air, can alter their landing formation.

12. These forces can seize objectives in areas inaccessible to other modes of transportation.

13. The small landing area required, and the ability to lift and land vertically, make it possible to concentrate large forces in a small area in a short period.

14. Conventional ground fortified areas can be ignored, assaulted from the rear or enveloped with relative ease.

Perhaps the greatest contribution by the helicopter to the assaulting Landing Force is the favorable probability of survival under atomic attack. The natural dispersal of the helicopter waves enroute to the landing areas coupled with their relatively high cruise speeds offers the solution to the ship to land operation which is impossible of attainment with present or projected surface assault craft. It permits immediate assault of enemy areas which have been subjected to tactical atomic bombing. The vertical envelopment of enemy troops whose senses are stupefied with shock would assure nothing less than success to the attacker. END

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KOREAN BOOMERANG—Like Lockheed's famous Hudson Bomber ("Old Boomerang") of WW II, the F-80 *Shooting Star* has proved rugged in combat. Built to take terrific battle damage yet return to base, the F-80 did exactly that in Korea . . . another "Boomerang."

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BEGINS WORK ON GIANT JET BOMBER

Production of an undisclosed number of giant B-47 jet bombers has begun at Lockheed's Marietta, Georgia, factory.

As the world's leading producer of jet aircraft and modern high-speed transports, Lockheed is especially qualified to build the Boeing-designed B-47's for the Air Force. Production floor space at Marietta, plus Lockheed's California factories, makes Lockheed as large today as the entire U.S. air-frame industry in 1940.

What's going on at Lockheed?
Lockheed has developed a high-speed camera with a speed range of from 1,000 to 3,000 frames a second. At 3,000 per second, a 100-foot roll of 16-mm film goes through the camera in 1¼ seconds. Purpose of the speed: to check results when fast-dropping die hits a blank piece of metal. Objective: development of stronger, new-type alloys for greater, faster aircraft ... Another current research project creates arctic flying conditions 20,000 feet above the California desert. On an actual F-94 All Weather Jet Fighter, a spray bar shoots a fine, foggy mist on the nose and wing, building up layers of ice. Plane's de-icing equipment is thus tested in actual flight.

Past and future at Lockheed...
One of Lockheed's earlier transports, a Model 10 Electra, is approaching its 25,000th hour of flying time, in continuous service since 1937 for South Coast Airways, Pty., Ltd., of New South Wales (Australia)... New Lockheed Super Constellations, in service by year's end, will be the largest, fastest, rangiest commercial transports in service. So well have earlier Constellations proved themselves around the world that more than 100 Super Constellations were ordered before the first production model flew... The new Lockheed-developed thin wing for the advanced F-94C—so thin it looks almost fragile—is strong enough to support two fully-loaded Super Constellations (150 tons dead weight)—one at each wing tip. This new plane, America's continental defender because of its electronic superiority, contains enough installed electrical power to supply a small community.

The Padre's on Deck

(*Continued from page* 138)

Clergymen entering the Navy Chaplain Corps for the first time are sent to the Chaplains' School of Indoctrination at Newport, R. I. for an intensive, eight-weeks course in naval functions and terms. After graduation they are assigned either to aircraft carriers, battleships or destroyers, or to a naval base. Service is rotated. The chaplain serving aboard an aircraft carrier may later be assigned to the Marine Corps ground troops. However, although he wears the Marine uniform he retains his naval rank.

Large aircraft carriers like the *Boxer* have two chaplains aboard, a Catholic and a Protestant. A battleship may have three or four including a rabbi.

The Navy Chaplain Corps is proud of its record dating back to 1775 when the Continental Navy, in its regulations adopted November 28, 1775, decreed:

"The Commanders of the ships of the thirteen United Colonies are to take care that divine service be performed twice a day on board, and a sermon preached on Sundays, unless bad weather or other extraordinary accidents prevent."

First mention of a chaplain in the Journals of The Continental Congress refers to the chaplain's share in the distribution of prize money. On January 6, 1776 Congress passed a resolution which included the provision:

"The Commander in Chief have one twentieth of the said allotted prize money . . .

"That the lieutenants of marines, surgeons, chaplains, pursers, boatswains, gunners, carpenters, the masters' mates, and the secretary of the fleet, share together, and have two twentieth parts and one half of one twentieth part divided amongst them, equally of all prizes taken when they are in company."

On November 15, 1776, more than a year after the first vessels had been authorized, Congress fixed the pay of officers in the Navy. The base pay of the chaplain was $20 a month.

Chaplains have long proved their ability to accept their share of hardships along with the men and many have died in the performance of their duty.

"When an LST drops its ramp the chaplain goes ashore with the men," Chaplain Salisbury said. "He says: 'Boys, here we go!'—and he goes with them!"

Although the Corps has been fortunate in not losing any of its 28 chaplains who served in Korea, several Navy chaplains lost their lives in World War II. The first two, Chaplains Thomas L. Kirkpatrick and Aloysius H. Schmitt, were killed when the Japanese attacked at Pearl Harbor. Chaplain Kirkpatrick was aboard the ARIZONA; Chaplain Schmitt, the OKLAHOMA.

Chaplain George S. Rentz gave his life preserver to a young sailor as the two clung to a lifeboat after the Aircraft Carrier HOUSTON had gone down in the battle for Java.

"I've lived my life," the Chaplain told the boy, "yours is just beginning."

The youngster refused the life belt but the Chaplain took it off anyway, said a brief prayer for the men clinging to the boat and swam away. Shortly after he disappeared.

Four Navy chaplains were taken prisoners by the Japanese in the five months' campaign waged to conquer the Philippine Islands. They were Earl Brester of the *Holland*, D. L. Quinn of the Sixteenth Naval District; F. J. McManus of the *Canopus* and H. R. Trump of the Fourth Marine Regiment. McManus and Trump were on Corregidor during the last days of its defense and were made prisoners when it surrendered May 6, 1942. Their fight to be allowed to hold divine services for the men is a story in itself.

When a recruit comes into a Naval Training station two people greet him—his drill instructor and the chaplain. The chaplain welcomes him and tells him he is his friend. Said Admiral Salisbury:

"The military training makes him a man. We do the rest. We hold lectures on sex education, the basic moral principles, marriage and family relations, and citizenship and religion.

"Fifty per cent of the men coming into the service have had no religious training. Mind you, we don't cram religion down their throats, but if they are interested, we are there to give it to them." He added:

"The chaplain's job is to bring God to man—and man to God!" END

Wings of Gold

(*Continued from page* 105)

ting, from all the Naval and Marine Air Reservists in the fleet. For the past five years, we've been saying they're good. Now they are proving it in action!"

This comment came from a man who knows what he's talking about. He's been a Naval Aviator for almost 30 years and during World War II was captain of the flattop HORNET. Right now he commands a carrier division in the fleet.

The end of hostilities in 1945 by no means brought an end to the world's unrest. The Navy Department realized that it must be prepared to meet any threats to America that these conditions might breed. During the war it had spent about $25,000 each to train some 60,000 aviators. In addition most of these men had obtained a priceless asset: combat experience purchased only by fire, fear and blood. Navy air and ground crewmen, too, were experts in their fields. Without them no pilot or plane can fly. Their knowledge had to be saved, too. Postwar military budgets prohibited a large full-time Naval Air Arm. Naval-Marine Air

Reserve was the answer.

Using less than one cent of every defense dollar to operate its proficiency maintenance program, Naval-Marine Air Reserve keeps six pilots or technicians in fighting trim at about the same cost that would be required to keep one of them on full time active duty.

During the months of late 1945 and early 1946 when America was disarming at a breakneck rate, Reserve pilots, air and ground crewmen were returning to civilian life by the thousands. Immediately after separation some of these men continued flying and working on planes at their nearest Naval Air Station "to keep their hands in." In the meantime the administrative groundwork was being laid for the efficient and far reaching Naval-Marine Air Reserve of today.

Organized squadrons patterned after fleet squadrons were first commissioned at twenty-one major cities throughout the United States on July 1, 1946. They have grown and developed ever since. Naval Air Reserve can now man over fifty-five carriers of the mothball fleet with trained aviation personnel faster than the carriers themselves can be readied for action!

Because of their Saturday and Sunday once-a-month training, these men were called "Weekend Warriors." The average "Weekend Warrior" flies about 100 hours a year including his regular annual two-weeks active duty training tour aboard a carrier or at a fleet air station. He uses one or more of 15 types of combat and service aircraft including such post-war models as *Panther*, *Phantom* and *Fury* jet fighters.

Last year Naval and Marine Air Reservists flew almost 900,000 flight training hours in over 2,000 planes with the outstanding safety record of only 5.4 accidents per each 10,000 hours flown. Included in the 5.4 figure are even the most minor of accidents.

While the majority of squadrons are of the carrier fighter or attack types, there are reserve patrol, lighter-than-air, transport, and fleet air service squadrons.

Each pilot during his weekend training periods works as a part of his squadron carrying out a syllabus designed to maintain proficiency. This is no Sunday flying club. Every minute the pilot is in the air is used in formation tactics, gunnery, navigation, bombing or any one of the hundreds of other chores required of Naval Aviation. Marine Reserve Squadrons naturally emphasize close air support of ground troops.

Prior to the Korean War, squadrons of Naval Air Reservists went aboard fleet and training aircraft carriers during their two-weeks annual training duty. Aboard, they utilized their own organization and supporting personnel. They kept up to date on carrier operations which have been changing and constantly improving since the Reserves were on full time active duty in 1945 or '46. During the Korean operations this phase of the reservists' training was conducted at fleet air stations because of the non-availability of carriers. There, too, bombing, anti-submarine, rocket firing, simulated combat strikes and other operations required in air-sea warfare were practiced.

Marine Air Reserve squadrons spent their two-weeks active training duty on maneuvers at El Toro, Calif., or Cherry Point, N. C. Working closely with Marine ground troops they sharpened up their close air support specialty. An Army General in Korea testified to the effectiveness of this training when he was asked what he needed for his offensive then underway. Looking up at a flight of strafing *Corsairs*, he said, "Just one thing. More of that Marine close air support."

No matter how good a pilot is, he is no better in war than his support. To keep him flying, many specialized ground crewmen must assist him. To keep the pilots in the air, the Organized Reserve weekend training includes classroom, shop, radio, control tower, photo lab, ordnance, and other technical work for specialists in these fields. Ground training under competent instructors using about 20 million dollars worth of training equipment keeps the technicians of the Reserve up to date in Naval Aviation.

Although most of the pilots of Naval-Marine Air Reserve are World War II veterans, many of the enlisted technicians are youngsters who got their start in Naval Aviation within the ranks of the Reserve.

Pilots, like everyone else, grow older as the years roll by. Right now the aviators of Naval-Marine Air Reserve are as good or better than they were in the last war. Korea has proven this. But the time is drawing ever closer when they'll have to take the back seat for a new generation of Naval Aviators. Provision has been made for the gradual transfusion of new blood to replace the old. That is the Naval Aviation Cadet program.

A qualified youngster who wants to become a Naval Aviator enlists in the Naval Reserve. Upon acceptance as a cadet he receives 18 months of intensive flight training followed by 30 months of active service and experience in the fleet as an Ensign if Navy, or as a Second Lieutenant if he's a Marine. At the end of this tour he returns to his home and is encouraged to join in his nearest Naval or Marine Air Reserve squadron. Although it's not compulsory—he usually does. As an added incentive many industrialists and businessmen have organized to help him find civilian employment in areas nearest to Naval Air Reserve Stations or Training Units.

Only a relative few of the squadrons of the Reserve were recalled to active duty to fight in the Korean War. The exact strength of the squadrons remaining in a standby status is guarded by military security, but like their comrades who acquitted themselves so well in Korea, Naval-Marine Air Reserve stands ready to meet any threat to America's security. END

Whirly Bird

(*Continued from page* 75)

blade tip, the question of weight would not be too serious. The mixing department of the engine could be back in the fuselage some place and mixed fuel could then be fed up through hub and rotor to the combustion chamber.

Such an installation would have a lot of advantages. First, of course, is the more efficient use of power. Then comes the ease of pilot control of rate of flow of fuel; the much greater fuel capacity (and so range and speed); the lack of a transmission system as the hub would need only a bearing to rest on; and the lighter weight of the rotor blades.

The Navy firmly believes that the helicopter has "not yet begun to fight." Already the egg beaters have replaced fixed wing aircraft for use aboard battleships and cruisers and there is no reason to believe that, in the not too distant future, there may be collapsible helicopters stowed aft in submarines and forward on destroyers. As someone said, "The only thing a 'copter won't do is what it hasn't been asked to do."

The list of the helicopter's abilities is already long although it has just begun. For instance, when the U.S. Wildlife Service found, for reasons only known to itself, that it wanted a count of muskrats, a Navy helicopter obligingly counted the critters. Or the case of the ex-K-9 corps members who had grown not only wild but dangerous around Sandy Hook. Not forgetting their war training, these dogs were a menace and could not be caught. Attempts to hunt them on foot failed so, at last, they were tracked down and shot from helicopters. And then there was the 'copter which rescued a fawn trapped by a forest fire. Or scare the bejabbers out of poachers doing a little out-of-season murder.

In the field of rescue the capabilities of the 'copters are almost infinite. Men have been picked up out of the sea, off sinking ships, out of the clutches of Koreans and the fond embrace of Chinese "volunteers."

Helicopters have carried just about everything from mail to females. They have been used to study traffic problems, watch schools of fish, carry a caribou (shot by the pilot) back to the ship (presumably for caribou steak—an extremely rare delicacy), make soundings of the ocean, fly shark patrol for swimmers, and dry off pastures for model airplane meets.

This already lusty baby is, if the Navy has its way, going to grow up to be quite a man. When the problems of speed, stability, ease of navigation and piloting are solved, the Navy helicopter of the future may well be as sleek a plane as any jet fighter of today. It may, indeed, be a jet powered fixed wing airplane which carries in its fuselage the rotor of a helicopter. This dual purpose plane could get there in a hurry and then hover all day; it could combine all the capabilities of both fixed and rotary wing planes and, possibly, add some capabilities not yet even considered. END

Scratch a MIG

By Lieut. Cmdr. W.T. Amen

AT 1005 on November 9, 1950, one MIG-15 fired on the Corsair leader of our strike group from a steep high-side run as our attack planes retired in column south to their rendezvous area after a bombing run on the Sunuiju-Antung bridges.

The Corsairs immediately changed their rendezvous point and the MIG pulled up vertically and came down about 3,000 yards behind my division of F9F's. We had not seen him but when an F4U pilot called him out as "right behind our jets," four necks swivelled as one and I spotted the MIG at 7 o'clock, level and closing.

We turned into him and passed head-on—no chance to fire. The enemy jet went under us, then pulled up into a right chandelle. As I turned left to scissor him I was agreeably surprised to see him straighten out after only 180 degrees of turn. From then on until he was hit he behaved like a student pilot midway through the "dogfight" syllabus. But he was flying a much better aircraft than any student I had ever instructed.

The chase began down around 3,000 feet, worked up to the base of the overcast at 15,000 feet and back down again during the 10 minutes it lasted. The MIG gained distance in straight-away climbs and climbing turns but always turned back into me while still too close to get in a head-on run. He showed a tendency toward high-speed stalls in his tighter turns, which may have been due to the occasional burst I was able to lay up ahead of his nose from hopelessly out of range.

He was never able to out-turn me and he never stopped trying, for which I gave thanks. At any time he could have straightened out and pulled away in a climb or dive to recommence the fight on his own terms. When we reached the bottom of the overcast he could have disappeared into it. Occasionally he changed direction of turn, practically signaling his intention beforehand.

Had he been a student on a check-flight I would have been forced to give him a down-check. As it was, he helped me administer a permanent "down" when he began a 30-degree diving turn to the left at about 7,000 feet. By cutting across, I was able to close to within about 1,500 feet, meanwhile exceeding maximum allowable speed. As we reached 3,000 feet, my airplane began to build up a "buffet" which forced me to stop firing and pull out. Out of the corner of my eye I saw the MIG pilot pull his nose up and flip onto his back as if to begin a split "S." As he was only 900 feet above the ground I didn't think much of his chances.

My wingman observed small pieces of MIG breaking off as I fired during this last dive and my three companions watched him hit going straight down. He exploded.

Accent on Opportunity

Until recently Private First Class Myron Jarman of Beverly Hills, California, was a student at Santa Monica City College and U.C.L.A. One day he read of the 45 career fields in the U. S. Air Force training program, and recognized his chance to combine his interests and aptitudes in creating a responsible job for himself.

Soon after enlisting he became a student machinist. In the photo, he is "blanking out a lathe model." Under his instructor, Staff Sergeant Albert D. Clark of Loveland, Colorado, Airman Jarman will learn mechanical drawing, blue print reading, use of small hand tools, lathes, milling machines, contour machines, shapers, heat treating and grinding.

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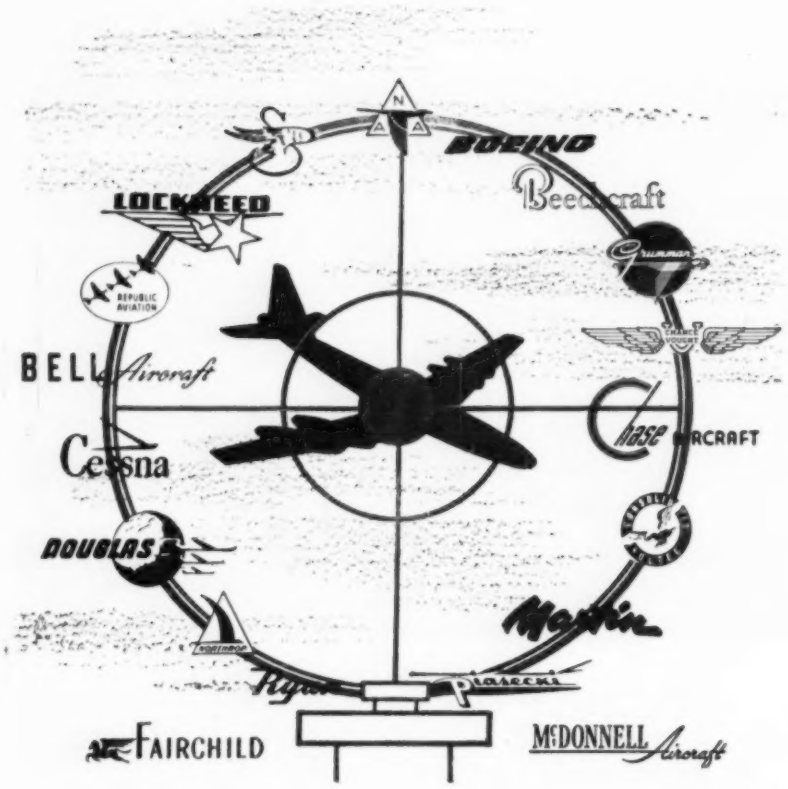

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Paddle Wavers

(*Continued from page* 135)

better come take a look.

Unbelieving, he went topside. It was dark and snowing heavily. Visibility was near zero. He could hear the returning planes but, try as he might, could not see them.

The crew made all necessary preparations to bring them aboard and the ship turned into the wind. After 35 minutes of "I can't see you and you can't see me," the LSO had all four planes safely aboard. Then he and the pilots went below for some much needed hot Navy coffee.

The LSO's job calls for precision, timing, good judgment and experience. A pilot himself, he is the key man aboard an aircraft carrier during landing operations, and it is his judgment that determines whether the plane shall land aboard or not. He undergoes extensive specialized training at the Carrier Qualification Training unit at Pensacola and leaves qualified for the "Paddle Pusher's racket."

The LSO and the pilot by necessity are one of the best co-ordinated teams in the Navy. Pilots are trained in carrier landings on the "bounce field," a simulated carrier deck ashore. There they learn proper carrier landing procedure and techniques. The LSO works with them on the bounce field too. The more work on the bounce field the better the team when the time comes to operate aboard ship.

The LSO works with a bright colored signal paddle in each hand so the pilot can see him at a greater distance. While some of his signals are merely indications to the pilot for an improved approach, two are mandatory—the Wave Off (both paddles waved over the head), which means pull up and try again, and Cut (LSO's right arm brought across chest in cutting motion), which means land right now.

Signals in addition to the Wave Off and Cut relayed to the approaching pilot via the LSO's bright-colored paddles are: Roger (arms extended horizontally to the LSO's sides) indicating the approach is OK; Low (both arms lowered at angles from the Roger position) the plane is too low—come up some; High (both arms raised at angles from the Roger position) the plane is too high—let down some more; Come On (both paddles brought in towards LSO's face from Roger position) the plane is too slow—speed up; and Fast (right arm dropped to right leg from Roger position) plane is too fast—slow down.

The occasional accidents usually make landing signal officers gray before their time. Which is why so many of them try to wangle other jobs—besides they are pilots themselves and would much rather be in the cockpit than waving the paddles. But they usually wind up where they started—with a pair of paddles in their hands, bringing them aboard. Old landing signal officers never die, they just wave away. END

Bombs, Bullets

(Continued from page 140)

healthy place to be, since the bomber boys know the pursuit curve too, and can be expected to insure a warm reception. A fighter flying into the hail of bullets from a bomber's tail turret, is, to put it mildly, at some disadvantage.

In fact, radar may be considered as much of a boon to the armament designer as the jet engine is to the airplane designer.

The eyes of the human being, which are not at all equal to the task, are supplanted by mechanisms which find the target and track it regardless of weather or visibility. The computer, another mechanism, receives the tracking information, reckons in the necessary factors (such as own speed, target speed, bearing and range) and computes the proper bearing for the airplane or guns in a time which would be impossibly short for a human being. Finally, the range-radar determines range to an accuracy which the pilot couldn't begin to match, thus establishing the proper firing moment.

A great deal of the credit for the research and development of these fire control systems is due to the Aviation Armament Laboratory of the U. S. Naval Development Center located in Johnsville, Pennsylvania. This laboratory was established as the fruition of a long cherished dream of the Bureau of Aeronautics to have set up a physical facility where "long hair" armament projects could be "bread-boarded" and their theory proven before private industry could be asked to manufacture such items. In order to keep a reasonable degree of practicality in their projects, there is included a judicious mixture of experienced and technically trained naval officers and development engineers who keep the scientists from letting their hair get too long.

To further the development story, once the new development is satisfactorily demonstrated, it is set up in a pre-production model, or even into full production. It is then installed in the type service aircraft for which it was conceived and full evaluation tests are made.

Navy fighter and attack aircraft have other fighting capabilities than interdicting enemy aircraft. They may carry streamlined multiple rocket containers capable of launching large numbers of rockets at high rates of fire for air-to-ground use. Also the combination bomb rack and rocket launcher enables them to carry, at will, either the 5" high velocity aircraft rocket or 500 pound bombs. Other Navy fighters, having heavier bomb racks, can carry 1,000 or 2,000 pound bombs as well as napalm tanks or bombs. Thus when the occasion arises, as it has time and again in Korea, valuable close support can be given to ground troops, or alternatively surface targets can be effectively attacked.

The attack aircraft of the Navy, the AD and A2D, *Skyraider* series, are modern versions of their famous forebear, the SBD *Dauntless* which did such yeoman service in World War II. These aircraft can carry over a dozen rockets, up to 6,000 pounds of bombs, mines, torpedoes, depth bombs, napalm, and other weapons, in addition to two or four 20mm guns. Computing gun sights, radar range, and radar searching aids are provided for the fire control. A Bomb Director enables the pilot to carry out glide bomb attacks with the accuracy of dive bombing. Special emphasis is being given to the development of extremely accurate automatic fire control equipment for close support purposes such as dropping bombs or firing rockets to the precise spot desired by the ground forces.

The heavier attack and patrol plane types are capable of carrying a 12,000 pound pay load in form of bombs, mines, depth bombs, and other droppable stores. These aircraft will carry the Navy's successor to the old Norden bombsight with improvements. These improvements enable precision bombing to be done, using radar "eyes," from very high altitudes, at high speeds, regardless of weather or visibility conditions. Improved handling, suspension, and release equipment are being supplied to the Fleet to enable aircraft to be reloaded rapidly and to insure reliable and accurate releases.

These airplanes are also to be provided with modernized remote controlled turrets in the tail and perhaps in other positions. Thus the crew can ride safely and comfortably in the pressurized portion of the airplane and merely monitor the operation of the uninhabited turrets with their newer fast-firing 20mm guns.

Many weapons and devices, such as special anti-submarine bombs, the new 5" high performance Air-to-Ground rocket, mines and airborne underwater sound detection equipment, have been provided for specialized hunter-killer aircraft whose primary function is to find and kill enemy submarines. In such operations, helicopters, lighter-than-air ships and especially configured *Avengers* (the old "work horse" of the last war) plus the newer A2F *Guardian* series, would work as a team in anti-submarine work.

Let us consider the temperature problem. A carrier is steaming along somewhere in northern waters. Because it is in the open sea and it happens to be a somewhat balmy day, the temperature on deck is a pleasant 70°F. The radar on the ship picks up an unknown group of aircraft approaching high and fast. The carrier's fighters are quickly launched and climb rapidly to challenge the oncoming aircraft. When they reach 50,000 feet and the time comes to fire the guns, no noise! If and when the fighters return to the carrier, the guns and all their accessories are found to be completely coated with ice.

This is what has happened. When the aircraft first took off, the guns were relatively warm. As they climbed into colder air, the guns were chilled. When, during maneuvers, the guns encountered warm air, heavy condensate was formed, and the very low temperatures froze the condensate, thus jamming the guns. Special low temperature lubricants are necessary since the low temperatures at high altitudes, e.g., —65°F is frequent—congeal ordinary grease and oil.

Well, that's easy, one might say. Just insulate the gun compartment, exclude air, and provide some heat. But unfortunately, if this is done, something else, which is decidedly unhealthy for the airplane, happens. When four 20mm guns are enclosed in a compartment and fired rapidly, large quantities of gases, which are the products of the explosions of the cartridges, collect. This gaseous mixture is frequently explosive in nature and requires only a spark or a red hot gun part to set it off, with consequent dire results to the airplane.

Long and exhaustive research has solved this apparent dilemma. By providing fresh air to just the right spots in the gun compartment during the time of firing and for a short time after firing, the mission can be successfully accomplished. Heat is provided constantly; thus it is possible to keep the guns warm and dry and still rid the airplane of the explosive gases.

The very high speeds of modern combat introduced another problem which had to be carefully considered. As the airplane nears Mach 1, or the speed of sound, it becomes extremely sensitive to buffet and shock loads. Every effort must be made to keep the external configuration of the airplane as clean as possible. Every protuberance is a potential source of trouble in that it may induce local shock waves which lead to buffet.

This problem was recognized in 1945 and studies were begun by the Navy at that time to determine the optimum shape of externally carried stores such as bombs, auxiliary fuel tanks, and gun or rocket packages. Not only were shapes studied, but also the effects of placement of stores with respect to the wings.

The studies have culminated in the selection of a streamlined shape which has now been applied to a series of new bombs, fuel tanks, and externally carried rocket launchers. Up to this time these stores have been flown as fast as the aircraft which carry them can go with no evidence of buffet. Moreover, there have been remarkable reductions in the parasite drag induced by these stores, as compared to the drag of previous external shapes.

In concluding this brief outline of naval aviation armament, it is fitting that some mention be made of its "poor relation," the towed target. All of the armament for air-to-air combat must either be manned or monitored by human beings, and in such an exacting matter as air combat, it is essential that these human beings be trained in as realistic a manner as possible. It is obviously impossible to practice firing against other aircraft —in peacetime, anyway—and it is extremely expensive to use drone aircraft for this purpose. The answer is the towed target. Although towed sleeve and banner targets can be and are being used, they do not provide a realistic target, nor has it been possible to tow one of these at speeds much over 350 mph. The Navy's answer to this problem is the Aero Winged Target. This is a relatively cheap towed glider, with a 24 foot wing span, which has already been towed up to speeds of about 500 mph. Its successor is expected to be towed at over 550 mph.

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Battles Shape Aircraft

(*Continued from page 69*)

The *Panther* was the first Navy jet to fly under combat conditions. Soon after the Korean communists crossed the thirty-eighth parallel it was rushed in to counter their movements. On November 9, 1950, a *Panther* piloted by Lcddr. W. T. Amen shot down the first MIG credited to any naval aircraft and the second one destroyed by United Nations aircraft.

Even before the outbreak of war in Korea, the Bureau of Aeronautics began developing other jet fighters. A number of these are now flying and will soon join the fleet. The sleek, swept-back F3H *Demon* and the delta winged F4D *Skyray* are single-engine fighters designed especially to intercept the enemy's high speed, high altitude bombers. New electronic gear is making the twin-engine night or all-weather fighter into an outstanding general purpose aircraft. This type is represented by two aircraft. The conventional shaped F3D *Skyknight*, is characterized chiefly by its very clean streamlining; the bug shaped F7U *Cutlass* has extreme sweepback and utilizes such aerodynamic innovations as combined ailerons and elevators, or "ailevators."

These four models incorporate both conventional and unconventional features. This is a matter of special importance since the radical designs promise great advances but pose great problems. Doubling up on lines of development provides insurance that the Navy will remain ahead in the design of intricate modern fighters. With two tactical types, which these four aircraft represent, the Navy will seize and retain control of the air.

The strategy of Naval aviation is built upon a balanced force. Fighters gain control of the air, then the attack planes destroy the enemy. For example, during World War II the fighters knocked out the Japanese local air power while the scout-dive-bomber and the torpedo-plane-horizontal-bomber struck at island strongholds.

In adapting its forces to the requirements of the present, the Navy has found three types of attack planes to be necessary. The general purpose attack plane, as typified by the AD *Skyraider* and the AM *Mauler* carry out dive bombing and torpedo attack. A special anti-submarine aircraft, the AF *Guardian*, is one answer to the threat of high speed snorkel submarines. A long range attack plane, the AJ *Savage*, can destroy targets that lie beyond the reach of the general purpose attack planes.

The F4U *Corsair*, although strictly speaking a fighter, has many characteristics of the general purpose attack planes. Its versatility during World War II was a major factor in the development of postwar attack planes. Hence, it is no wonder that the Marines in Korea considered the *Corsair* to be a favorite close support plane. In addition it proved the equal of those enemy fighters that ventured far from the Yalu river.

The general purpose attack planes differ from the World War II dive bombers and torpedo planes in that much special purpose equipment has been eliminated. Designers found that they could increase the aircraft's speed by abandoning flexible guns, and pilots agreed that the higher speed gave them better protection than did the guns. Another feature in the design of these aircraft was the elimination of the bombbay; this resulted in a lighter airplane and one that was more versatile. The *Skyraider's* ability to carry bombs, rockets and torpedoes in many different loading combinations has been highly praised by combat pilots.

A newer general purpose attack plane, the A2D *Skyshark*, has already been developed and it differs from the *Skyraider* primarily in that it is powered by a turbo-prop rather than a piston engine. These engines will insure the *Skyshark* a position of dominance for years to come and is evidence of a well rounded development program in which attack plane development paces that of fighters.

During World War II the carrier based torpedo plane proved to be the most effective answer to the German submarines. Thus it was only logical that the Navy continue to develop the attack plane's potential against submarines. As one step, the *Skyraider* has been adapted to the requirements of anti-submarine warfare, and it promises to be very effective under most conditions.

However, the threat of submarines is world wide, and the

Navy must be able to destroy them in any climatic or geographical area. This requirement led the Bureau of Aeronautics to develop the special anti-submarine warfare attack plane, the *Guardian*.

Neither a single *Skyraider* nor a single *Guardian* can carry all of the complex gear required to locate and destroy submarines, so special search and attack versions have been developed. The search model carries extensive detection equipment which the pilot uses to find submarines. The attack model then delivers the final blow to the enemy.

The remaining attack plane, the long-range, high-altitude bomber, is capable of flying from carrier bases to attack distant targets with explosives that will insure their destruction. This type is definitely a postwar product. Initial tactical development was carried out with P2V *Neptunes* which were adapted to carrier operation, while the North American AJ *Savage* was being built especially for this mission. First the *Neptune* and later the *Savage* demonstrated that carrier operation of large twin-engined aircraft was possible. The effectiveness of the type was underlined in 1949 when a *Neptune* took a 10,000 pound bomb load off a carrier and flew 4,000 miles, dropping the bombs at the half way point.

Of special interest in the *Savage* is its power system, which consists of two Wasp Major engines plus an auxiliary turbo-jet engine. This combination gives the airplane the range and economy of proved piston engines and a reserve of power needed when penetrating enemy fighter barriers.

The attack planes and the fighters make up the striking power of the aircraft carrier. They will be a mighty force during any future war, as they were during World War II. However, the carrier force must depend upon long-range patrol planes which warn of approaching enemy forces, thus permitting the carriers to concentrate their power. The patrol plane has many other uses; it can bomb shore installations and in this capacity it serves as an attack plane. It can neutralize distant waters by laying mines, and it can search off-shore waters for submarines thus releasing the anti-submarine carriers for duty in mid-ocean.

Prior to World War II, all patrol planes which the Navy developed were flying boats. However, in 1941 it became clear that the Navy required long-range landplanes to complement its flying boats in both the Atlantic and Pacific Oceans. Since there was no time to develop landplanes to meet Navy requirements, Air Force planes were obtained and modified to Navy requirements. Since converted bombers could not be as satisfactory for Navy use as aircraft that were built as patrol planes from the ground up, the bureau of Aeronautics soon decided to develop its own long-range landplanes, and contracted with Lockheed for the P2V *Neptune*.

The *Neptune* was the Navy's first attempt to build a long-range landplane to its own requirements. Its success was announced to the world in 1946 when a P2V, the *Truculent Turtle*, piloted by Cdr. Tom Davies, flew more than 11,000 miles, from Perth, Australia to Columbus, O., to establish a non-stop non-refueling record that is still in effect.

This flight indicated that the *Neptune* was well chosen to replace the *Liberators, Privateers, Ventures, Harpoons* and *Mitchells* that the Navy used during the war. The experience of the next few years validated this prediction and the *Neptune* has more than equalled expectations for both general and anti-submarine patrol, and has proved adaptable to operation as a carrier based long-range attack plane.

In addition to the *Neptune*, the Navy has developed the Martin P4M *Mercator*. This model, two years later in concept than the *Neptune*, shows the influence of postwar trends to a more marked degree. Two Wasp Major engines and two auxiliary turbo-jet units give it both high speed and good fuel economy. Pilots in patrol plane squadrons are looking forward to its early assignment to operational squadrons.

While the land type patrol plane demonstrated its value to the Navy in World War II, it supplemented rather than replaced the flying boat, and both types of development have been continued in the postwar years.

The outstanding flying boat of World War II, the *Mariner*, still remains in service and it has been equipped with wheels thereby making it capable of alighting on either land or water. At the same time new flying boats have been developed.

Many flying boat designers now feel that landplanes larger than the B-36 will be both uneconomical and unwieldy because their landing gear weighs many tons, and because they require runways that are both heavy and long. If these designers are right, the flying boat might well regain the dominating position it held during the 1930's when it pioneered in both military and commercial long range over water flights.

These theories may be proved with the P5M and the P5Y. These two aircraft are products of a revolution in flying boat design. The Navy, working with the NACA at the Stevens Institute of Technology and at Langley Field, has learned how to build long narrow hulls that are lighter than those of the earlier flying boats and yet not liable to damage by rough water. These hulls also have a streamlined shape that is comparable to that of land planes. The P5M and the P5Y are the first flying boats to incorporate these features. The two aircraft differ somewhat in concept, the P5M being in some ways a development of the *Mariner* and using the same gull-shaped wings and forward hull section. However, its long after body and deep step are new.

The P5Y is even more advanced. The four 5,500 horsepower turbo-prop engines which power this monster of the air and sea are but one indication of its capabilities. The design is so much a child of modern hydrodynamic research that the design engineers checked new theories by building a radio controlled flying model.

By remaining aware of both tactical changes and technical improvements the Navy has led the way in postwar aircraft development. The three classes of combat aircraft, the fighter, the attack plane and the patrol plane have made extensive progress in only six years since Japan surrendered. Turbo-prop and turbo-jet engines, high speed research, and hydrodynamic improvements have all been incorporated in new aircraft which the Navy will use to deter any aggressor. END

"Yes, Gentlemen, it will completely revolutionize air-sea strategy!"

Mugu Guides

(*Continued from page* 125)

tinued and some progress was made through the years, but it was spotty and slow. Not much money was available to keep the ball rolling.

World War II opened the eyes of the world to the possibilities of guided missiles and caused old Senor Cabrillo's California beach to be brightened up into the Naval Air Missile Test Center (NAMTC) of today. Complementing the missile proving grounds at Coco, Florida, and White Sands, New Mexico, Point Mugu's main job is exactly what its title implies—test and evaluation of guided missiles and their components.

Being a new outfit with a new job to do in the Navy, NAMTC's organization required a few departures from the traditional Navy set-up. Its subdivisions, uniquely labeled "Test and Evaluation Facility," are staffed by both Navy and civilian engineers and technicians. This technical phalanx and their associated contractor personnel carry the load at Point Mugu. It is interesting to note that even the skipper at NAMTC, Capt. Joseph N. Murphy, USN, is a little different,—his daddy and granddaddy were Navy captains, too.

In addition to its main job, test and evaluation of guided missiles, the Center places great emphasis on ground checking. One doesn't have to be a "slide rule boy" with a string of technical degrees to know that preflight checks are vital when he learns that the cost of a single test flight may run into five figures. Like any other complicated mechanical gadget, all components of a guided missile must function perfectly. Malfunctioning of any component part may cause flight failure and great loss, not only in dollars, but in priceless scientific data as well.

Other NAMTC functions include the training of military and civilian personnel in the who, what, why, where, when and hows of guided missiles, as well as contractors' laboratories in the development of certain electronic equipment for instrumentation of the Sea Test Range.

In case you haven't heard of a Sea Test Range before, it is, in the case of Point Mugu, an island target and launching site for dangerous missiles located 50 to 100 miles off sunny California's shores. It has its own set of requirements—naturally. It must be uninhabited yet readily accessible by water or air. It has to have shallow water or semi-submerged rocks where targets can be erected. Water within five to 20 miles of launching sites must be deep enough for maneuvering ship targets. And a convenient system of islands or beaches must be available for observing and tracking launched missiles.

Inhabitants of Point Mugu have their own names for who does what, and they aren't as complicated or as hard to understand as one might expect. The Missile Test Department, Component Test Department, Range Instrumentation Department, Technical Service Department, and Technical Information Department all smoothly fit into the overall guided missile pattern of the Test and Evaluation Facility of NAMTC.

These aren't just a bunch of high sounding names of gobbledegook. Unraveled they spread themselves out before the unpracticed eye something like this—all of which spells GUIDED MISSILE.

Missile Test collaborates with contractors towards developing, flight testing, and evaluation of complete guided missiles and pilotless aircraft. In other words they launch 'em, test 'em and grade 'em. Component Test works on the pieces, airframes, guidance, propulsion, parts of missiles plus the measurements, shock and vibration, and chemical factors of each.

Range Instrumentation develops and improves data gathering equipment for test flights as well as collecting the information from the use of the Sea Test Range. For the benefit of technical minded readers, Range Instrumentation also has to do with high-speed digital computers and servomechanisms services.

Technical Service designs, fabricates and installs special testing facilities, while Technical Information provides technical literature for, and resulting from, missile projects. It provides photographic coverage for testing activities as well.

Today the combined talent and resources of many universities, industrial concerns and government agencies are actively engaged in guided missile research, design and development. The logical succeeding steps—test and evaluation—are crucial. That is the spot where the U. S. Naval Air Missile Test Center, Point Mugu, completes the picture. END

Waves

(*Continued from page* 115)

aircraft gunnery.

The fourth and last phase deals with familiarization with aviation ratings. This includes descriptions of the duties of the rating and the qualifications which must be possessed by the individual. In addition, the various curricula of the technical schools are studied and practical work in each rating is given the students in order that a graphic picture is created of what she may expect in her chosen field. In this phase, emphasis is placed on qualifications and responsibilities of a petty officer in order to prepare the airmen for their next step up the career ladder.

Upon completion of the Airmen School, the trainees are classified and assigned for instruction to the appropriate Naval Air Technical Training schools. In these, they get specialized training and, upon graduation, they are assigned to their duties.

The introduction of women into naval aviation did bring up some problems just because they were women. An example is in the rating of parachute riggers. Many of the duties of this rating are so-called "naturals" for women: the sewing required in the repair of parachutes and life saving equipment and the careful folding of the silk for packing. The first problem noticed was that the height of the women averaged much less than men. Therefore, the packers, who work in pairs, on opposite sides of the tables, were unable to reach the center with enough strength to complete the final closing of the parachute container. The addition of raised walkways did not entirely overcome this.

The requirements for parachute rigger training thereafter included "not under 5 ft. 6 in. in height." The problem was still not solved because to effect the final closing, one woman of the team invariably held the container against her chest while the other forced the final closing. Future and permanent injury to the women could obviously occur. Faced with removing the women from this field of work, it took but a very short time to devise a tool which accomplished the closing with ease. That closing tool is now a standard part of the parachute rigger's kit—for both navy men and women.

When the Naval Air Reserve Training Command was established there was no authority given to integrate women into this program. Nevertheless, several women officers and enlisted women who had served with naval aviation during the war went to the squadrons and volunteered their services without pay. They offered to serve in any capacity in which they could be of assistance. These offers of service were thankfully accepted and the movement spread throughout the country. In December 1947, a group in Seattle got permission to commission an Associated Volunteer Unit composed of WAVES. Eight months later five such units were in existence. These units proved to be so helpful that authority was granted for their association with the organized squadrons, some in a drill pay and some in non-drill pay status.

This led to the present policy of enlisting women in the Naval Reserve with no prior military service and giving them recruit training. Hundreds are enrolled and more are continuing to join. That this step was a wise one was demonstrated when the international situation necessitated the recall to active duty of both men and women veterans in the Naval Reserve. The newest groups of women reserves are being trained in the various ratings through class and drill attendance and are serving in both a drill pay and non-drill pay status. The Naval Air Reserve Training Command pays high tribute to these women who devote their time and interest to assist in the accomplishment of training of a ready reserve. END

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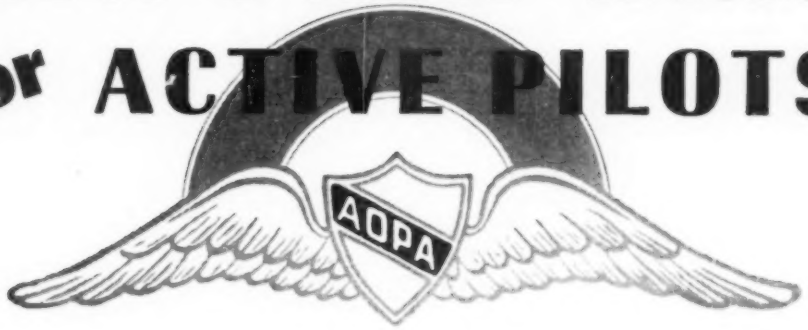

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They Step Into Space

(Continued from page 113)

what the parachute will do even before it is built. From an idea, it progresses to a blueprint and then to a full size test model. This test model is strapped to a torso-shaped rubber dummy weighing approximately 200 pounds and dropped at air-speeds far in excess of those it will encounter in service use. If it survives the dummy drops and still looks promising, the riggers—sometimes jokingly referred to by their shipmates as "live dummies"—take over.

Parachutes of the test design are live-jumped 200 or 300 times, each jumper filling out a questionnaire immediately after a jump, describing his impressions. These questionnaires, expressing the opinions of experienced men, carry a great deal of weight in the final judgment. If the test model survives this vigorous program; it is sent to a squadron in the Fleet for service test before final acceptance. By the time the parachute is put out as standard issue, practically all the bugs have had a chance to show themselves and be ironed out. The chute is now ready for production runs.

Parachute work is a story of constant development and improvement. And parachutes themselves are not all alike. They differ in size—from a couple of feet to over a hundred feet in diameter—and in type and shape as well. An example of recent development is the extended skirt canopy with a deployment bag. A standard, flat canopy has a bad habit of oscillating; and a landing during the downswing of an oscillation can be rough. The engineers added three feet of material to the bottom of a flat canopy; hence the nomer, extended skirt. Result—a parachute with negligible oscillation *and* a lower rate of descent. It also inflates more slowly which reduces the opening shock. The deployment bag lessens the shock even more. Normally when a canopy leaves the pack it immediately starts to inflate. The jumper continues to fall until he reaches the end of the shroud lines . . . and is stopped with a stiff jolt. Not so with a deployment bag. It keeps the canopy deflated until the shroud lines are completely paid out; then it falls off, allowing the canopy to blossom. The deceleration is much slower. It's the difference between a jerk and a strong pull. To a jet pilot opening his chute before his body slows down to normal free-falling speed it's the difference between life and death.

All the work of the Unit is not strictly parachutes. Today the problem of getting the crew of a disabled aircraft safely down to earth is becoming increasingly difficult. Speeds and altitudes are going up. No longer can a pilot simply climb out of a cockpit and fall free. At 600-plus mph the slipstream is like an iron fist. Even if a man were able to fight his way from the cockpit, the air rushing by with the force of six hurricanes could slam him into the wings, air intakes or tail surfaces, killing or seriously injuring him.

The solution? Shoot him. No, not an Americanized form of hari kari but an ejection seat. If the pilot of a 600 m. p. h. jet is forced to bail out, he throws a couple of switches, pulls a cloth curtain down over his face and "blam!"—a charge of black powder shoots him, parachute, seat, and all, completely clear of the aircraft. From there it's a relatively simple matter for him to drop out of the seat and descend via personal parachute.

A possible alternative to the ejection seat is a chute (not a parachute) with a shielded exit, allowing the crew to leave where there is little possibility of being struck by part of the aircraft. Tests involving the "laundry chute" have been conducted successfully at speeds up to 440 m. p. h. The ejection seat, however, seems to be the more satisfactory; its positive action is a decided advantage when an aircraft is gyrating, oscillating or spinning violently.

A major difference between a test firing and an actual emergency is that the test seat carries a parachute of its own. Five seconds after the jumper leaves the seat this parachute opens, lowering the seat to the ground with only minor damage. A few hours work and it's ready for another shot. Since a test seat costs more than a new Cadillac, the extra parachute is well worth the extra work.

Freeing the pilot or crew member from an aircraft is only part of the high speed, high altitude problem. For example, a pilot flying at 43,000 feet is in a pressurized cabin breathing pure or nearly pure oxygen; the latter depending on the degree of pressurization. Suddenly separate him from this pressurization and oxygen supply and he would lose consciousness in approximately 20 seconds; he would die from lack of oxygen in about one minute. If his parachute were to open at that altitude, the shock would be terrific, possibly as high as 40 g's. So if he bails out, he must take a supply of oxygen with him. He must be protected by a well insulated flying suit. And before opening his parachute, he must free-fall to lower altitudes where the atmosphere, besides being breathable, acts as a brake. Since altitude judgment is very difficult, particularly over water or snow, and since an injured pilot may loose consciousness during the free-fall, an automatic opening device has been developed. Working somewhat on the principle of an altimeter, the device automatically pulls the ripcord when a pilot falls to a predetermined altitude.

Under consideration at present is a jettisonable pod or escape capsule. This pod would normally function as the pilot's compartment. In emergency the unit, a veritable "citadel of safety," containing the pressurization gear, oxygen supply, and survival equipment, could be separated from the remainder of the aircraft and lowered by a large parachute. Of rugged construction, it would afford excellent protection in rough terrain; and being watertight, would become a life raft deluxe in an open-sea landing.

One of the Unit's recent projects was the development of a parachute system for an Arctic survival kit. In the early stages of the Korean conflict pilots who bailed out or crash-landed behind enemy lines were ill-equipped to withstand the cold weather. A suit of clothing suitable for a plane's cockpit, for survival in the icy water off the coast, and for footing it across the mountainous terrain was impossible. Burdening each with equipment suitable for all contingencies would have cut down the fuel and ammunition load. Something was needed which was small enough to be carried on the bomb rack of a fighter, yet contained all the necessary survival gear. The Arctic kit appears to be the answer. It can be quickly flown in and parachuted to a downed flyer. Containing a sleeping bag, warm clothing, boots, food, and even a small combination rifle and shotgun, it gives the downed pilot a better than even chance in the coldest weather. Of immediate use in Korea, it was primarily designed for use in the far north or south.

Another project of the Unit is the development of a quick-acting canopy release. A parachute, man's best friend at one moment, can be a deadly enemy the next. After a landing in a high wind—"high" being anything over 15 m. p. h.—a jumper is in danger of being dragged by his still-inflated canopy. Spilling the wind from the canopy after landing is a task not always easily accomplished, especially if the jumper is injured. This was tragically demonstrated during World War II when El Centro was a Marine Corps training base.

A pilot who bailed out near Yuma, Arizona, some 60 miles east of El Centro, was dragged to his death over rocks and cactus. Nor is the danger restricted to land. At sea, drowning replaces the rocks and cactus, but the hazard is no less real. The canopy releases eliminate this hazard almost entirely. In less time than it takes to read this sentence, a parachutist can easily free himself from a canopy and from the risk of death or serious injury.

A word about the personnel in the Unit. All of them, as you can guess, are not parachutists. Planes have to be flown. Those same planes have to be maintained in flying condition. Ejection seats have to be rigged, checked and loaded. Telemetering equipment has to be assembled and calibrated. Photographs—movie and still, ground and air—have to be taken, developed and printed. These and the many other jobs are the less spectacular part of the parachute experimental business. But they're none-the-less important.

The jumpers themselves are not a group of do-or-die daredevils. Nor does a jumper run around with a perpetual grim determined look on his face. He may be tall or may be short; he may weigh 120 pounds or 210 pounds; he may be an officer or an enlisted man. He'd be Mister Average-guy, except that he wears silver parachute wings and is proud of it. And because of him and the other men in the Navy Parachute Experimental Unit, Tom from Massachusetts can climb into his patrol plane, Dick from Oregon into his divebomber, or Harry from Texas into his fighter; and each can be certain his parachute *will* let him down easy. END

Looking Back

(*Continued from page 53*)

men will operate land machines in the prosecution of our work does not necessarily indicate that we have in any way encroached upon the Army's territory."

The logical outcome of the Navy's emphasis upon flying boats appeared in the NC-class. These very large aircraft for their day, with four motors and a wing span of 126 feet, were designed to cross the ocean under their own power and to come down anywhere at sea with good expectation of survival. Although they were completed too late to engage in wartime operations, the Navy decided to put them to the test. On May 8, 1919, three of the big boats took off from Rockaway Beach, New York. One, the NC-4, reached Plymouth, England, on May 31, having proceeded by way of Newfoundland, the Azores, Portugal and thus became the first aircraft of any nation to cross the Atlantic.

The return to peace in 1918 left naval aviation with many difficulties to surmount. Fortunately, when Congress established the Bureau of Aeronautics in 1921, the Navy appointed as its chief, Rear Admiral William A. Moffett, one of the great figures of American aviation. Between 1921 and 1927, on a budget that rarely exceeded twenty million, he produced amazing results. The first successful radial engines, the Norden bombsight, metal hulls for seaplanes, and a series of racing planes which, in 1923, enabled the Navy to hold 23 world records may stand as examples.

In 1919, the Secretary of the Navy authorized the conversion of a collier into an experimental carrier. This ship, rechristened the *Langley*, but better known as the "old covered wagon," joined the Fleet in 1922. On its decks were worked out the techniques of carrier operation, arresting gear developed, and many other notable experiments carried out.

When the *Lexington* and *Saratoga* appeared in 1927, BuAer had the equipment, the pilots, and the skill to raise United States naval aviation to that leading place which it has since held.

Well before World War I, Rear Admiral Bradley Fiske had suggested the aerial torpedo and had taken out patents on the subject, but it was well along in the twenties before the Bureau of Aeronautics had developed suitable aircraft, the Bureau of Ordnance, workable torpedoes, and the pilots usable methods of dropping.

Another basic tactic, dive bombing, originated with the pilots themselves. The idea appears to have occurred to many aviators both in the United States and abroad. Navy and Marine fliers, however, at first with little encouragement from outside, saw the possibilities and pushed this type of attack. It was first used operationally against an enemy by a Marine Squadron in Nicaragua during 1927. The first aircraft designed as a dive bomber appeared in 1930.

The ability to produce new plane types, indeed to prosecute more vigorously the whole progress of naval aviation, resulted from the creation of the post of Assistant Secretary of the Navy for Aeronautics and a five year development program for naval aviation.

The basic tactics of the twenties were largely worked out on the individual plane basis. The thirties saw the introduction of squadron and group tactics, the coordination of which Mustin had spoken. Changes and improvements came tumbling forth almost faster than the record book could take them down.

The instruction of war took many forms: improved radars and radios, increased protection on the ships against fire, better training in damage control, larger, speedier aircraft capable of greater ranges, tactics tried in the heat of battle, more accurate ordnance of augmented explosive power, and above all the fast carrier task force.

Before the war no fleet commander had ever exercised more than two carriers in maneuvers. Analyzing the experience of 1942 responsible commanders—the young aviators of twenty years before grown a little gray, a little wiser—came to the conclusion that, if the carriers operated in groups of three or four surrounded by their supporting battleships, cruisers, and destroyers, many advantages would accrue. Fewer aircraft would be required per carrier for protection, thus releasing additional offensive power. The greatest concentration of antiaircraft fire known would greet any enemy who eluded protective fighters. Two or more such task groups operating together would constitute a fast carrier task force. By the autumn of 1943 they were ready.

The rest appeared in the daily papers, and is still being set down in more accurate detail in the books of history. Starting at Tarawa the great Central Pacific offensive began its long swell, gathering momentum as it moved westward, always spearheaded by the Fast Carriers running their interference for the Marines and soldiers who followed in that motley array of ugly ducklings—the landing ships and craft of amphibious warfare.

The epic of the fast carriers should not obscure the other contributions of naval aviation to the control of the sea, which means simply the ability to do what one wants upon the ocean and to prevent the enemy from doing what he wants.

The United States in World War II used its sea power to launch amphibious campaigns in two oceans. Where landings occurred beyond the range of land-based air, naval and Marine aircraft from small escort carriers afforded air support until fields ashore could be put in operation. In two wars the Germans, a shrewd and resourceful enemy, tried to dispute allied use of the sea with submarines. In both successful antisubmarine campaigns naval aviation played a decisive part. Great land offensives in Europe were supported by a bridge of ships across which flowed men and supplies under the protection of allied surface vessels and naval aircraft. Japan, like the United Kingdom an island empire, was brought to the verge of defeat when United States submarines and aircraft cut its lines of communication to the sources of raw material.

Naval aviation does not control the sea but it contributes to that vital objective. Sea power in its contemporary manifestation requires careful integration of forces on the surface of the waters, in the depths below, and high in the air above. END

Calculated Risk

(*Continued from page 50*)

courtesy calls on the flagships but many of their constituents obtain admission cards from the American Consul which can be had for the asking. And any Italian can see that a nineteen-year-old American sailor rarely looks like an "imperialist war-monger" when he goes into a shop and asks timidly "quanto" for a pair of ladies' gloves, size six. Occasionally, the Communists vent their frustration by painting signs on the walls, as they did recently in Nice: "Go home, U. S. Navy" and, just underneath, "Korea for the Koreans."

Just what will be the effect of this seeing-the-world in the best tradition is hard to say. It's difficult to find an isolationist in any ship's crew and most sailors seem to believe the U. S. is in the world to stay. But the only concrete evidence ever seen this month was on a blackboard notice in the Saipan's ready room: "Return cups to the coffee table, s'il vous plait."

Vice Admiral Gardner, at 53, is one of the homeliest men in the U. S. Navy. His gaunt face has been smashed portside, starboard and head-on . . . souvenirs of aircraft crashes more than two decades ago. He survived those crashes and led "The Three Flying Fish" who used to skim through the skies, then suddenly flip over on their backs and continue flight in this position. The other two "Fish," Aaron Putnam Storrs and Frederick MacKay Trapnell, are also admirals now.

In World War II "Matt" Gardner got started as Chief of Staff to Admiral John S. McCain, Commander of aircraft in the dark days of the Solomons. He was credited with planting an airfield on Espiritu Santo, which was, for a time, Guadalcanal's sole outlet to the world. Later Captain Gardner commanded the famed carrier Enterprise in the great Truk raid of February 1944 (32 ships sunk) and in the "Marianas Turkey Shoot" (400 planes destroyed). After the war savvy Matt Gardner as a rear admiral was the Navy's chief strategic planner.

Last March Admiral Gardner was handed the most important command of his career: the U. S. Sixth Fleet, which includes the bulk of the naval forces that would clash immediately with the Russians in case war came to Europe. Gardner took over from Vice Admiral John J. Ballentine who succeeded the late Forrest Sherman when Sherman went back to Washington to become the Navy's top admiral late in 1949. END

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Clearing the Decks

(*Continued from page 71*)

fabric adapter catches the plane's nose wheel which causes the cross deck steel cables of the barrier to be thrown up behind the nose wheel to catch the strong main landing gear. Sounds complicated but it isn't, and it really works, bringing the plane to an effective stop with far less damage than could be done by the old unmodified type barrier.

While not actually a part of the development of the carriers themselves, the operation of jets aboard carriers has caused many changes in operating procedures on flight decks. For example: How about the danger of jet blasts to men working about the deck? It's not nearly as dangerous at it may seem at first, for the jet blast is dangerous only in a small area immediately behind the plane, and a man is warned by the hot air long before he gets close enough for a hot foot. Propellers don't give this warning. Because jets are so fuel hungry at low altitudes they aren't started until the last minute. This coupled with fire resistant clothing worn by flight deck crews keep the danger to a minimum.

Improvement programs similar to those on the ESSEX class, tailored to ship's missions, Navy Yard capacity and available funds have been carried out to modernize other classes of carriers. The MIDWAY class, as well as the smaller light and escort carriers have been included in the modernization program.

Progress is a continuing thing. As aircraft continue to grow and exceed performances, that a few short years ago were not even dreamed of, progress in the means of handling and servicing them must maintain the pace.

The defense of the free world requires that war, should it start, be carried to the heart of the homeland of the enemy. Now and in the forseeable future the aircraft carrier is the Navy's best weapon for doing just that. END

Wings and Lens

(*Continued from page 137*)

a story of the first torpedo mission of the Korean war. It was flown by Navy attack pilots attached to Air Group 19. These aircraft, operating off the Carrier PRINCETON, launched torpedoes against the flood gates of the Hwachon reservoir dams in east central Korea.

It was photographic intelligence that elected the type of weapon used against the dams. From pictures taken previously it was known that the gates were 20 feet high, 40 feet wide and 2½ feet thick. The planes twisted and dived around 4,000-foot ridges to reach the short curving leg of the lake that leads into the dam. They had just enough water distance to level off at the proper altitude before they reached release point. Photographic planes covered the attack. Pictures taken showed the tin fish destroyed one gate and made a 10-foot hole extending below the waterline in the second. Three of the torpedoes exploded at the center of the 200-foot high dam, which is 900 feet long. A fourth damaged an abutment at one end as can be seen in the accompanying photo on page 137.

Jet aircraft have posed problems in naval photography just as they have in almost every field of aviation. With the design of a new plane for the Navy, complete plans are approved for that plane's prototype as a photographic plane, if acceptable, and the photographic version is manufactured right along with the tactical version. This allows a squadron to take off complete with the combat planes and the photographic planes as a team—all the same type, the same speed, the same fuel, the same maintenance requirements back on the carrier. The combination of new jet planes with practically no space for cameras, their increased speed, and the need for precision photography, poses a problem for the Bureau of Aeronautics in redesigning nearly all of its aerial cameras to meet these new requirements.

Today's photographic jet aircraft cannot fly safely at 120 knots. Cloud cover and other factors which may require much lower altitudes present no choice in the type of camera which must be designed to meet these new conditions of photography. The cameras must be smaller, with faster shutters, faster recycling time, more automatic in operation and much lighter in weight.

The Navy's new cartographic camera has solved this problem. This camera was designed to provide great accuracy without sacrificing interchangeability of component parts. Small fiducial marks on each edge of the picture enable the photogrammetrist to determine the exact center of the photograph by drawing lines connecting these points. A precise relationship exists between the principal axis of the lens and the fiducial marks of the focal plane. The cartographic camera can encompass an entire city and its environs, with an accuracy permitting precise interpretation.

Guided missiles are mighty nice weapons. However, they are small and generally good for one ride only—destroying themselves on contact at the end of the flight. So far we have been unable to develop a small-type human willing to take a one-way ride. If this could be done, the suicide-bent character would pencil in a few choice observations on what's wrong with missile 8369, so it could be corrected on vehicle 8370.

The missile must be "tracked" on film during its initial take-off period and throughout the length of its flight, in order to detect abnormalities in its flight behavior. The acceleration camera was

designed to photograph the initial stages of the flight. When set exactly perpendicular to the trajectory, this camera will provide the distance, acceleration, and velocity of the missile during the first 200 feet of flight. The camera, operating at a precisely known speed, will allow the exact computations regarding the flight of the missile.

The actual flight of the missile is recorded by photo-theodolites. This instrument is a combined theodolite and camera, and its placement with regard to the path of the missile is previously known, as is the exact time each picture is made. Working on somewhat of a motion picture camera basis, it can take from one to four frames per second, usually four, and each exposure is accentuated by radio control. Usually at least three cameras are stationed in a triangle to the path of the missile, up to four miles or more away from the path to assure complete coverage. The placement of the cameras assures the necessary triangulation to permit computation of the exact place of the missile in space at any given time. The radio control feature guarantees that every corresponding frame of every camera was exposed at exactly the same instant. The photo-theodolite contains two scales, one showing elevation and one showing azimuth angles for each frame. This information is imposed on each negative by two small dials appearing in the upper corners of the picture, and an additional dial in the upper center showing the frame number.

Color film helps make Mama glamorous in home photography, and has done a lot for Hollywood, but the reason it is used in guided missile work, is that it provides better definition of the missile (a dark object against the sky) and also improves the reading of the film by a lessened amount of grain in evidence. A special type of high contrast color film has been developed for the purpose of tracking missiles.

After the film is processed, it is turned over to the film readers and mathematical departments on the research base. Tables are made from each frame showing mathematically the position of the missile in space at that particular time. These departments, sometimes called "data reduction offices," reduce the visual impressions on the film to chart and tabular form for ready examination, and prepare a complete arithmetical record of each frame made by each missile.

Although the present cameras are providing information of a quality conducive to testing of missiles in space, much improvement in this type photography is constantly being sought. The Bureau of Aeronautics has constructed an improved type of acceleration camera at the U. S. Naval Aeronautical Photographic Experimental Laboratory in Philadelphia, and the Naval Ordnance Test Station, Inyokern, Calif., has designed an improved mount for its lenses. These cameras are being supplied to both Navy and Air Force activities. Improved plans are being promulgated for future procurement in an effort to keep the availability of good photography abreast of requirements in the technical advances of the Navy. END

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Equipping the Cockpit

(*Continued from page* 121)

if not impossible. A plane spinning at 600 mph nails you in the cockpit for the duration. And, even if you could get out, your chances of getting tagged by that tall tail are better than excellent.

Here again BuAer stepped in and took over from the pilot, leaving him with only the decision to make. If he has to get out of there, he pulls a BuAer device called a pre-ejection lever. This opens the canopy and, when there is nothing but heaven in the way, the device goes on to arm the kick-in-the-pants department. The pilot then puts his feet in some stirrups, stands at attention, and hits the "panic button"—a small curtain which, when it comes up to protect his face from windblast, also fires the catapult cartridge. Somehow, this device also disconnects the "spinach" so that the pilot, seat, gear, prayers and all fly off into space. Even here BuAer does not abandon him to his own devices. After the seat has cleared the airplane still another device lets out a drogue parachute. When this has slowed the seat-bound pilot to a safe speed and steadied the whole contraption, BuAer is content at last to turn things over to the pilot. He opens his safety belt, gets clear of the seat, and, at present, pulls his own ripcord.

So much for 600 mph-45,000 foot situations where, in modern Navy flying, a man is practically walking on the ground. But what about getting out where the cold is deadly, there is no air, where the force of deceleration from a 1000 mph gait or better is unbelievable, and windblast is like being smacked by a falling bank vault?

The Navy's BuAer is coming up with all the answers to this in one capsule. It's a trim, streamlined capsule with, as usual, BuAer's almost fiendish automatic devices. In fact, this capsule is the entire cockpit, controls, seat, pilot and all and is just buttoned on to the rest of the airplane.

The simplicity—from the pilot's point of view—of the cockpit capsule surpasses even that of the ejection seat. This time he only has one thing to do from the moment he decides he'd be better off somewhere else until he gets somewhere else.

He pulls a lever.

Things happen. The whole cockpit shoots away from the rest of the fuselage. At the same time (since BuAer doesn't want its pilots to be tumbled around in outer space) fins appear, turning the cockpit into a stable glider—at speeds around 1,000 mph. However, as it slows down the fins lose control. Before any tumbling can start, though, the drogue parachute pops out and stabilizes it some more.

Finally, when the pilot's little floating home has slowed to a comparative crawl, a large parachute takes over and lets the cockpit down to earth, hitting not much faster than a man falling in a standard 'chute.

If it lands in the water the pilot doesn't even get damp. The thing makes a serviceable boat and is packed with survival equipment suitable for Arctic wastes or enemy infested jungles.

During the descent, of course, the cockpit holds its pressure and is insulated against the intense cold. However, if the pilot feels that he must get out of this happy home, he can just pull another BuAer lever and he's on his own, dangling below his personal, old-fashioned hand-operated parachute.

This mechanical marvel department investigates everything relating to the man in the machine. Navigators, for instance, make errors if the astrodome isn't optically correct, or are killed by pressure if an astrodome breaks. Now Airborne Equipment has come up with a Periscopic Sextant which not only takes the altitude of a star but can fill in as an astro-compass or give you the average altitude of that same star for any two-minute period while the navigator can be found in his bunk below.

* * * * * * * * * * * * * * * *

"We must continue in the future, as at present and as in the past, to pursue with unabated vigor all honorable avenues for the peaceful resolution of international controversies. We must cooperate with our friends of the free world and continue to make full use of collective security, but we must remember that it is the strength of America which has made our nation great, and it is the strength of America which will preserve us in the days ahead."—Admiral Forrest Sherman, May 19, 1951.

* * * * * * * * * * * * * * * *

An hydraulic system using a petroleum base fluid is a fire hazard anyway and when you boost the pressure to 3000 pounds per square inch as BuAer does in its control apparatus, even a small leak would be disastrous. So Airborne Equipment worked up a water-base fluid (H-2 hydrolube) which won't burn and won't freeze down to minus 160 F. The same outfit developed a coating for fuel tanks which makes them able to stand 2,000 F for more than 5 minutes. And it has done much to develop titanium alloys as strong as the best alloy steels, but weighing far less. Chrome plating the cylinders of "hot rods" was first thought up by the Navy's BuAer and no one will be greatly surprised if the only sought "transparent aluminum" comes out of the shop to solve many of the problems of aerodynamic heat.

From welding rods to a grease which is still greasy at minus 300 F; from football helmets to detachable cockpits, from jet engine tail pipes to foolproof landings, Airborne Equipment spreads its attention, working always closer to the perfect airplane. This dream would be the true "flying machine." The pilot might have to hold a small gadget in one hand, perhaps a control panel of some sort, with which he could transmit his wishes to the airplane, or the day might come when he could simply talk to it the way a farmer talks to his mule. END

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Navy on Prowl

(Continued from page 107)

"I've been bucking headwinds around that circulation for 14 hours and all I want is a little gasoline—just 800 gallons —PLEASE!"

"OK, it's your neck! Sergeant, call the motor pool and have them break out a gas truck for that Navy plane parked near the tower. Let's go see aerology."

The Aerologist looked up from his charts with an amused smile. For 28 months he had predicted every typhoon within a 500-mile radius was going to hit the base. Now his latest prediction was coming true and he was enjoying every minute of it. He picked up a sheaf of hieroglyphics and started in professionally, "Wind is East North East 45 with gusts up to 60, ceiling and visibility reduced in rain squalls to . . ."

"I know what it is here," interrupted the pilot, "but what will it be in Tokyo in three hours? My plane's due for a check, and if I don't get in tonight, I'll have the Maintenance Officer, the Operations Officer and the Skipper all breathing down my neck for the next week."

"Well," said the dismayed weather-guesser, "it will clear up past Osaka and you'll have a 2,000 foot ceiling and light rain in the Tokyo area." He signed the pilot's clearance and turned his attention to a chattering teletype.

Back in Operations, the Duty Officer checked the clearance and said, "Sorry the gas truck was so slow, but they had it all tied down in the corner of the hangar. Here's your clearance copy. Good luck."

"Thanks," muttered the pilot and forced himself against the gale back to his plane.

"All ready to go, sir," shouted the plane captain, "we got 1,000 gallons aboard and the strainers show no water."

A jeep appeared out of the rain and the driver yelled into the pilot's ear, "Base Operations Officer says to take off on runway 4 at your own discretion. No traffic in the area to Osaka. We just abandoned the tower."

The driver disappeared and the pilot climbed the ladder and settled in his seat. The warm engines caught immediately and after a thorough check of all instruments, the plane swung onto the runway and vanished into the gathering gloom. "Gosh," said the pilot as he flipped on the auto-pilot and settled back in his seat, "These long patrols sure are monotonous. Nothing ever happens."

That's the tale of one "routine" patrol. There are others which consist of 12 or 14 or 16 hours of just staring into dark blue water, or into an opaque radar scope. There are also "routine" patrols which end with blood in the turrets, with part of a tail gone, or a wing. And sometimes the story is told in a brief communique, "One of our planes is missing. . . ." But it is more than a plane, it is a patrol plane and a patrol plane crew.

Patrol planes have been called the "eyes of the fleet." With the advent of the joint military action in Korea, they have become the "far-reaching eyes of the United Nations." Crews, highly trained in the art of sea and coastal reconnaissance, roam alone thousands of miles from their bases, in all kinds of weather. Their job is collect and disseminate important information to interested land, sea and air forces.

Every day, both east and west of the Korean Peninsula and for many thousands of square miles of ocean surrounding the rocky battleground, patrol planes are on the prowl. Night finds them again on the hunt in many areas of enemy activity. Although shipping reconnaissance and anti-submarine patrol are their primary functions, there are other jobs.

These jobs include weather information sweeps ahead of tactical support aircraft, typhoon reconnaissance—which means locating, finding direction of movement and storm's intensity—and spotting for naval gunfire. At night there is enemy harbor illumination to check shipping, illumination of enemy positions for attacking aircraft and interdiction of enemy mine-layers. Enemy radar stations and mine-fields must be located. There is the search for downed airmen and transfer of wounded personnel from ship to shore. There is protection of naval units from coastal batteries and downed airmen from enemy fire. Photographic missions must be flown, floating mines destroyed, intelligence matter delivered to units at sea—routine functions.

These missions are performed by the patrol aircraft, Mariner seaplanes, the four-engined Privateer landplane and the hard-hitting long-ranged Neptunes. All of these types gross some 32 or more tons. To describe them as merely compact and complex is to describe them in a reticent fashion indeed.

The P2V *Neptune* fuselage is a slender steamlined tube 75 feet long. The wings reach out thinly 50 feet each side of the hull centerline. Into this constricted space must go some 10 tons of high octane gasoline in bulletproof tanks. These tanks are inter-connected to the engines through a maze of tubes and transfer pumps and vents. A half ton of high grade oil goes into tanks.

Twenty-five gallons of hydraulic fluid must be poured in so that, along with the various accumulators, pumps and pistons to operate the landing gear, flaps, bomb-bay doors, engine superchargers and gun chargers. Twenty-five gallons of alcohol solution go aboard to de-ice the windshields and keep the carburetors clear of ice. Fifty gallons of water goes aboard to inject into the engines to produce emergency performance. And, oh yes, last on the liquid list, 10 gallons of water for coffee, soup and drinking.

Affix one electronic automatic pilot and a multitude of instruments, gauges, controls, and circuit breakers to check flight, engine and electronic performance. Insert a heating and ventilating system capable of melting heavy ice off the wings, tail surfaces, propellers and windshield. This heating unit must also keep the crew from freezing at minus 40 degrees Fahrenheit. The ventilating system will preclude suffocation at 100°F.

Fine quality optical equipment is provided, including two aerial cameras, two high-powered binoculars, a precision octant for celestial measurement, and computing gun and bomb sights. In addition to the navigation lights, interior lights, instrument lights and recognition lights, there are two high-intensity landing lights and a signaling searchlight.

Then there is the offensive and defensive armament. The aircraft carries 10 machine guns, some in power turrets, with thousands of rounds of ammunition in cannisters and feed chutes. There are enough five-inch rockets to outmatch three broadsides from a destroyer, and additional bombs, mines, or torpedoes as the mission dictates. There are million candle-power flares, sonobuoys, colored signal pyrotechnics and smoke-lights. To all this add some heavy armor plate for protection of engines and crew members during battle.

In case of forced landing in enemy territory, adequate sub-machine guns, rifles, revolvers and knives are carried to equip a full-fledged riot squad. At various stations throughout the fuselage are located fire fighting equipment. Tool kits for emergency repairs by mechanics or electronics men are stowed in the corners.

All this equipment, enough, it would seem, to fill a two story house plus basement, must be arranged to accommodate the crew of ten men. Each man wears a life jacket, with emergency signaling equipment attached, and a parachute harness. Parachutes are distributed throughout the plane for quick attachment to the harness. Life rafts with emergency radio, sail, oars, signaling equipment and emergency rations are available. Emergency first aid equipment is provided for the wounded and oxygen for high altitude flight. Tubes and a stool are provided for the relief of the crew. Last but not least are cooking facilities and flight rations. On a long 16-hour flight, at least two meals must be provided, preferably hot.

The four-engined *Privateer* takes no back seat in complexity to the *Neptune*. Within reach of the two pilots in the cockpit of the *Privateer* are 168 electrical switches, 55 manual controls and levers and 50 instruments and gauges.

That's the story of what a patrol plane is and what it does. Such are the equipment and the mission of the patrol plane crew. There are other things that count. There are the 1,000 hours of training and preparation for the one hour of payoff action—if you're lucky. Take the World War II story of the anti-submarine patrol plane commander with 5,000 hours of ocean-gazing to his credit who finally sighted an enemy sub.

He got in fast and made his drop—the bombs failed to explode. After 5,000 hours of getting ready, his first opportunity was lost! Fortunately a young ensign with only 750 hours was right behind him in a second PBM. He made the kill. Was it worth it? Well, an average submarine cruise may well net the underwater killer 10 ships, 4,000 men. If those are our ships and our men, the 1,000 hours of preparation, even 10,000 hours is a small price to pay. END

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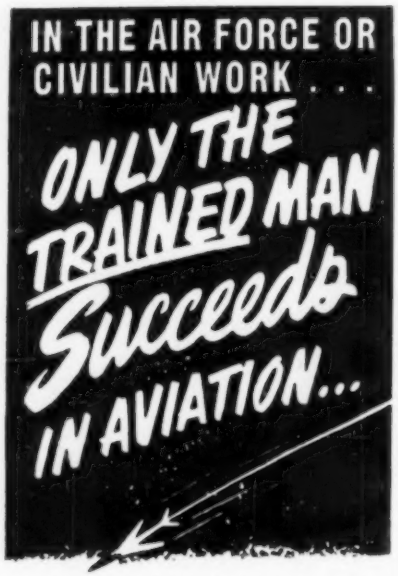

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Ordnance Packs Punch

(*Continued from page 127*)

to minimize possible earthquake damage.

The laboratory is equipped for basic and applied research in physics, chemistry, aerophysics, metallurgy and ballistics, as well as for development work on propulsion, fire control and guidance systems for rockets and other missiles.

Among its service facilities are a technical library, a large and versatile machine shop, a foundry, a standards of measurements laboratory, a materials testing laboratory, heat-treating and electro-plating shops and a controlled-altitude laboratory capable of simulating conditions at various altitudes, changing from one to another at a high rate of speed.

Special projects, largely in propellants and explosives, are carried on at two pilot plants, isolated from the community for reasons of safety. At night they look like neighboring villages as their lights twinkle through the soft desert darkness.

Armitage Field, the station's air facility, is of a size befitting the environment. The field was named for Lieut. John M. Armitage, USNR, a naval aviator who gave his life in testing aviation ordnance. Its runways span a mile and a half. Its hangars are large enough for B-29s. Since aviation ordnance is one of the main concerns of the station, some of the scientists make their headquarters in the buildings at the air facility.

After a new rocket has passed all preliminary tests, its launching gear or racks must also be tested to determine if they can take the shock of a carrier landing with a full load of unreleased rockets. This test is made right here in the desert on a true-to-life aircraft carrier flight deck. A carrier flight deck located in the middle of the Mojave Desert is a strange sight to see, but here it is. The deck is made of wood, equipped with wires to snag the tail hook, and all the essential equipment necessary to bring an aircraft aboard a carrier.

After a launcher developed for a particular purpose has withstood a series of carrier landings here in the desert, it is recommended to the fleet.

Armitage Field has another shipboard facility in its land-based catapult that can fling an aircraft loaded with bombs or rockets into the air with a run of only 75 feet. The rockets and launchers go through a series of catapult shots to test their sturdiness.

These shipboard facilities serve a dual purpose. They test rocket and bomb launching racks. At the same time they give naval aviators practice and training in making carrier approaches and landings, and in being shot from a catapult. The latter is important, for the fast jet planes of today require too long a take off run to make a normal take off and, thus, must be given the needed boost from the catapult to become airborne.

The Ram is not the only contribution of the station to the changing demands for more powerful and accurate weapons. The station distinguished itself in producing the first air-to-air rocket, the Mighty Mouse. This rocket, approximately 3 inches in diameter, will be carried in large numbers by the latest jet fighters at speeds near that of sound.

The Mighty Mouse already has been test fired from a supersonic sled rigged on a 6,000-foot track at the station. Scientists and engineers had designed this track to test the aerodynamic characteristics of rockets and other missiles traveling at supersonic speeds. The Mighty Mouse stood the strain. The fighter pilots of tomorrow can look forward to the day when they can cruise at ease about an enemy fleet, accurately picking off enemy bombers with the Mighty Mouse.

Photography plays a major part in all research, development and testing operations at the station. It serves as the solid foundation for an intricate system of instrumentation which provides detailed information on the test performance.

At the time every guided missile is launched on its brief career as a free-flying weapon, dozens of unblinking lenses follow its progress until it thuds into the sand and sagebrush many miles away. The Gooney Bird, an apparatus devised at the station, enables the photographer to track and photograph a missile traveling thousands of miles per hour. The Gooney Bird is loaded down with several different types of cameras.

The research devoted to underwater ordnance in an effort to increase our anti-submarine and underwater effectiveness is carried on at the station's Pasadena Annex, which operates a water range high in the mountains near Azusa, California. The Morris Dam range is equipped with the latest equipment and, at the time it was constructed, the largest all-welded structure in the country—a variable-angle launcher. This launcher was designed by station personnel and is used to simulate the release of projectiles from aircraft at different velocities and angles of attack. It is adjustable to any vertical angle up to 40°. One end of the 300-foot launching guide rests on pontoons in the water. The other is moved up and down on a ramp.

Compressed air propels missiles out of a launching tube, 22.5 inches in diameter and 300 feet long, into the water at predetermined speeds and angles of attack so that the action of a missile entering the water can be studied.

To coordinate the use of all facilities, including those for initial planning through to initial production, the staff of the Commander of the station carries out many evaluation and planning functions essential to operation of the station. Research, development and test activities are the function of six technical departments: Aviation Ordnance, Design and Production, Research, Rockets and Explosives, Test and Underwater Ordnance.

It is an accepted policy of the Bureau of Ordnance at the station that facilities of the Inyokern and Pasadena development center will be used whenever possible to collaborate in carrying out development and test programs for all three of the military services in the field in which the station is set up to work. END

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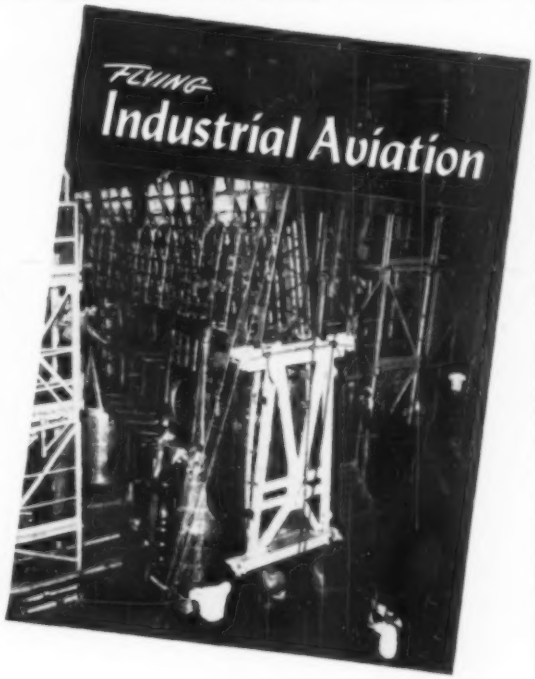

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Simulators

(Continued from page 112)

rise. He hears the rapidly rising whine of a jet engine and the rumble of wheels on a runway. When he pulls back on the stick the rumble of the wheels ceases, and the instructor cuts in, "Pull your flaps at 300 feet.—Let your airspeed increase to 300 knots.—Leave 100 per cent power on."

After a few seconds the instructor continues, "OK. — At 300 knots decrease power to 94 per cent. That's your best climbing speed, which should be about 4,000 feet per minute."

At this point student Gregory put in, "Which should I strive for, 4,000 feet per minute or 300 knots?"

The instructor came back, "300 knots."

Then after a pause the instructor spoke again, "Level off at 15,000 feet.—Decrease power to 82 per cent."

In this plane the tachometer reads in per cent of total horsepower or per cent of maximum rpm at total horsepower. The two terms are identical and interchangeable for practical purposes.

Now that Gregory is cruising at 300 knots and 15,000 feet, he is asked to "practice air work." Because he is an experienced pilot, detailed instructions are unnecessary.

The instructor orders, "Make standard rate turns in both directions."

All the while the instruments of an F9F installed in the trainer's cockpit and in the instructor's console reflect the maneuvers. Airspeed, bank and turn, gyrocompass, artificial horizon, fuel gauges and other instruments respond to the pilot's actions and the plane's attitude. The stick and pedals have the exact "feel" of the real airplane.

Presently the instructor says, "Practice climbs and glides. For glides reduce power to 70 per cent. Lower your dive brakes. This should let you down at about 3,000 feet per minute. Maintain 200 knots."

At around 5,000 feet the instructor cuts in with, "OK, raise your dive brakes and climb back up to 15,000 feet.—Level off and try a few slow rolls."

Here Gregory remarks that torque in a jet is a completely different matter from torque in a prop-driven airplane. Contrary to the popular conception, engine rotation is not the biggest cause of torque in a conventional piston airplane; the real devil is propeller wash and the force it exerts on wing, tail and control surfaces. A jet has no prop. Hence torque presents no problem.

"The very lack of torque," explains Gregory, "surprises the new jet pilot in the trainer just as in the plane. When the instructor calls for a few slow rolls much less aileron and elevator is needed to put a jet into a roll than one uses in a Corsair. The tendency is to go into a roll too fast and spin the airplane."

Paralleling practice on the Operational Flight Trainer, pilots study the F9F Maintenance Trainer. This equipment consists of a complete installation of each of the airplane's systems—electrical, fuel, hydraulic, etc., mounted on a separate panel. Here the pilot can operate each of the systems separately. He can push a button or turn a switch and actually see what each component in the system has to do.

The Operational Flight Trainer is the end product of many different kinds of scientific research. The training and experience of aeronautical engineers, electronic engineers, mechanical engineers, physicists, human engineers and many others entered into the solution of the intricate problems posed by this device. But if creation of the trainer was a long and difficult process, the vast reduction in training time, savings in pilots' lives.

The Navy trains thousands of men in the schools of its four training agencies which are the Bureau of Personnel, Bureau of Medicine, Marine Corps, and the Chief of Naval Operations. These training agencies use every modern technique and device available. Many of their methods, like the Operational Flight Trainer, have been developed at the Special Devices Center of the Office of Naval Research at Port Washington, Long Island, N. Y.

The Special Devices Center is unique within the National Military Establishment. It is the only agency in the Department of Defense which is devoted simultaneously to research, development, production, and utilization of training aids and devices, with the emphasis on utilization. The Center combines the function of a scientific research and development agency with the function of a procurement agency by producing and putting into practice the ideas resulting from research. It also fulfills the functions of an educational agency by supervising the utilization of training devices.

During the last ten years the Special Devices Center has developed six basic training concepts. The tools used to make these concepts bear fruit in improved training are: Synthetic Training Devices, Teaching Aids, Human Engineering, Research Tools, Tactical Evaluators and Training Methods.

Synthetic devices are the principal tools for the new training techniques. They put a trainee in a closely operational or combat situation where he is given every mental, physical or emotional task which he may have to perform in actual combat.

Teaching aids, as distinct from training devices, are smaller, and designed to teach the principle of a complex subject without giving a complete reproduction of an operational situation. The Aircraft Weight and Balance Trainer is such an aid. It is used to demonstrate to flight and maintenance crews basic theories applied to aircraft loading.

The third category is Human Engineering. It deals with fundamental psychological problems involved in operating ships and aircraft. These problems include analysis of human capabilities required for operational duties, and investigation of the psychological factors which may reduce or increase the effectiveness of certain equipment. A current project of the Human Engineering Branch at the Special Devices Center is the design of an optimum Combat Information Center.

It aims at maximum utilization of human abilities to achieve maximum efficiency in the operation of a CIC. Developing mass training techniques and evaluating existing training devices from a psychological aspect falls also into this field.

The fourth category of devices, is the research tool. For example, the Special Devices Center developed a human angular acceleration device to determine human tolerances under extreme conditions. The findings from this research, such as changes in blood pressure and body temperature caused by vertigo, will later be applied to aircraft design. The computers developed by the Center for applied research in aerodynamic design can be cited as another example.

The tactical evaluator falls into yet another category. Modern weapons have become fantastically complex. To determine their tactical possibilities and limitations by building prototypes requires enormous monetary expenditures which are beyond the reach of our economy. This difficulty is overcome by tactical evaluators. Prime example of tactical evaluators are guided missile simulators.

The last category are training methods. Training by synthetic methods, if it is to be successful, requires continuous technical guidance and assistance. Production, distribution and maintenance of training devices in the field, together with analysis of their validity as teachers come under this heading.

In terms of money, the savings made possible by the use of special training devices are difficult to evaluate. However, a few figures presented recently to the House of Representatives may serve as an example to illustrate the magnitude of possible reductions in training expenditures. It costs $10.00 an hour to train a crew of eight men to operate a patrol bomber in a special device, as compared to several hundred dollars in a combat aircraft. Bombing trainers produced by the Special Devices Center during World War II, at a cost of $2,500,000.00, saved in one year $25,955,684.00 in costs for using combat equipment. In addition, the use of these bombing trainers saved an estimated 119 lives, which would have been lost in training accidents during routine flights.

The activities of the Center are not limited to solving acute training problems. It is also concerned with training problems that may arise in a national emergency. One of these problems would be the insufficient number of qualified instructors available for conducting a training program of the size necessary to produce large and well trained troop bodies within a short period of time. There would be just too few instructors for such a job. The Center is trying to alleviate this anticipated difficulty by increasing the audience for each instructor so that one instructor may be able to teach thousands instead of hundreds of students. One of the means to increase an audience is television. The Center is currently investigating the suitability of television as a medium for mass training. The results of five years of research on instructional film will be utilized in this program.

END

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Big Whoosh

(Continued from page 129)

available for use by many contractors, progress in rocket propulsion would be slowed to a snail's pace. Many of the outfits with good ideas wouldn't be able to exploit them because as newcomers to the field, they don't have the money to build their own testing apparatus. NARTS affords maximum economical utilization of test facilities and assures the Bureau of getting what it contracted for in rocket engines and propellants.

One of the first jobs of the Rocket Test Station is the testing and evaluation of rocket propellants. Right here one should know that in discussing rockets the word propellant is not synonymous with fuel. Fuel is only one element of the heat producing combination in a rocket engine. The other is the oxidizer. Reciprocating or jet aircraft engines are furnished oxygen from the air. Rockets capable of operating in space beyond the atmosphere where oxygen is not available carry their own.

Fuels and oxidizers by their nature are high energy compounds needing careful handling. NARTS is studying many unusual propellants in its experiments. Chief factors affecting propellant utility are availability, ease of handling and storage and good ignition qualities. The first two of these properties are extremely important when considering rockets for shipboard use in the Navy, but others must be considered, too. For instance, rockets are notoriously high in their rate of propellant consumption. For this reason, the more dense a propellant is, the more energy can be obtained from a given volume.

The medical and industrial safety departments at NARTS are there to see that propellants are handled safely. Workers handling dangerous chemicals are safeguarded by special physical examinations and protective clothing. Blood tests to detect and measure hazardous substances entering a person's blood stream before becoming dangerous are conducted on regular schedules.

NARTS develops test equipment for rocket instrumentation when such equipment is not available commercially. Special instruments are required for rocket testing because temperatures and flow rate of rocket gasses are so high (sometimes over 5,000° F. and a mile per second). Also propellants are frequently corrosive as well as dangerous. Since there has never been a need for them before many of the test instruments are not available—they must be developed and made on the spot. Frequently many days are spent setting up a rocket engine for test and checking the calibrating instruments, although once set up many tests may be made in one day.

Other functions of NARTS are investigations of ideas, devices and propellants to provide a basis for future planning programs, and to assist the Bureau of Aeronautics in preparation of programs, detailed requirements for rocket engines, their parts, propellants, and associated equipment.

As in almost every Naval establishment, NARTS is a training institution in addition to its other duties. Naval Aviation personnel make the transition from reciprocating or jet engine mechanic to rocket engine mechanic in a hurry at Lake Denmark. Handling, servicing, and operations of rocket engines, their components and associated equipment becomes as familiar to them as the Model T engine to the mechanics of an earlier generation.

In case any Iron Curtain cloak and dagger men are getting ideas reading this, they might bear in mind that NARTS is guarded by United States Marines. Seventy-five per cent of them are Korean vets quite experienced in the use of their guns. END

Logistics Have Wings

(Continued from page 117)

planes went into overhaul, the 7 trips per week schedule still held. Cancellations were rare. On a number of occasions a *Mars* arrived in Alameda in the afternoon, received fuel and service, was reloaded and winging its way back to Hawaii in less than four hours.

The "normal" *Mars* load of 40 passengers between the West Coast and Hawaii, carried in plush comfort, gave way to record loads of up to 135 Combat Marines, carried in bucket seats. Ninety-three high-priority passengers were carried direct from the west coast to Japan with only three re-fueling stops in between.

Outstanding accomplishment is not new to the *Mars* outfit. The outfit holds several unofficial "weight and distance" records. Three hundred and eight passengers and crew were carried by a *Mars* from Alameda to San Diego on a routine flight some time ago.

How does one load over 300 passengers into even the cavernous space of the *Mars*? "Nothing to it," replied Lieutenant Dave Nicholson, skipper of the record haul, "just push passengers in the front until they start falling out the rear, latch the hatches and pour on the coal."

Record flights imply questions of safety. Since the "boats" were commissioned in 1946, they have amassed over 43,000 hours in the air without fatality or injury to any passenger or crew member. As a matter of further interest, no transocean cargo plane can touch the .2263c average ton-mile cost of the *Mars* operation.

Approximately 5,000 tons of cargo and 20,000 passengers were delivered westward by the FLAW squadrons during a year of the campaign in Korea. Compared to the 14½ million tons of cargo and 1 million passengers delivered by the Navy's Military Sea Transportation Service during the same period, this is a small portion indeed. But air transport's specialty is critical materials—anti-tank rockets for Marines when delay spells disaster, a single carburetor for a Navy patrol squadron could keep a plane and crew immobilized, or a bolt that isn't there could keep a carrier plane on the deck rather than in the air. The old aphorism, "For want of a nail, the shoe was lost, for want of a shoe . . .", still applies in warefare. Air transport supplies the "nails."

One of the biggest jobs handed FLAW in the airlift, was the transporting of nearly 1,000 combat Marines from the west coast to Korea. These troops were desperately needed as front line replacements in the Choshin reservoir area. The task was completed in less than one week.

In addition to the airlift effort, operations continued in the Atlantic and Continental areas. FLAW flights continued to service the Aleutians and Alaska. Air Transport Squadron FIVE is a veteran operator in these far North areas.

An experience, illustrating some of the freak weather conditions encountered on the northern run is described in one pilot's story following a trip to Adak.

"After passing through the high cone at Adak, I reduced power and lowered flaps and gear preparatory to the letdown. After continuing on an outbound heading for a few minutes, I received another "cone." It was confusing, but GCA took over about that time and I got down safely. Upon checking with Aerology I found that winds at the high cone altitude were well over 100 knots—sufficient to blow me back over the high cone with my speed reductions." A right stout breeze!

Even during the Korean campaign VR-24 stationed in London delivered 150 tons of mail and cargo to units of the Sixth fleet in a one month period.

The two ferry squadrons, VR-31 and VR-32, during a nine month period following the North Korean assault, delivered 4,107 planes over a total distance of 6 million miles.

An innovation in naval air transport has been the COD, i.e. Carrier On Board Delivery units, recently established in both fleets. The outfits, equipped with modified Grumman TBM *Avengers*, transport high priority passengers and critical cargo between aircraft carriers at sea and shore stations. Modified to carry six passengers, the TBM3Rs are equally at home aboard a flat top or on a naval air station.

If COD transportation is required, a dispatch designates a rendezvous point and two of the single-engine landplanes head out to sea. This service eliminates, oftentimes, the necessity of a ship-to-ship rendezvous or even a big carrier having to put into port for parts, mail or personnel.

The Navy, the first military organization to recognize the vital need for air transportation, uses its Fleet Logistics Air Wings to further create a compact, self-sustaining fleet unit. END

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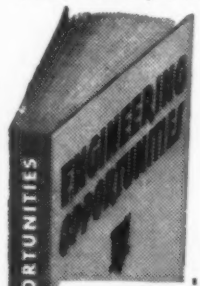

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(Continued from page 101)

training period at Whiting Field, the NavCad will get a chance to try a hand at actually flying the airplanes that he has lived with in text books and classrooms for the past 15 weeks. An intensive training follows until he hears "solo completed."

The solo flight a matter of history, the NavCad will continue to fly but he must concentrate on precision. Precision is a word he will continue to hear throughout his career as Naval Aviator. Everything he does from there on must be done with precision. He continues basic air work until he can do it backwards, forwards and in his sleep. He is then ready for acrobatics.

Most kids who have watched stunt flyers at air shows or country fairs have a general idea what sort of gyrations an airplane goes through to perform precision spins, loops, Immelmans and rolls but that first acrobatic hop—when a student finds himself hanging upside down with nothing but the safety belt between him and a parachute ride home—can be most perplexing. Aerial acrobatics take a little time to master but once a cadet gets the hang of it there is nothing he would rather do than stand on his head 8,000 feet over the Gulf of Mexico.

When the NavCad gains the self-confidence and flight smoothness that comes with successfully completing acrobatics he has spent about 16 weeks in BTU-1 and flown approximately 87 hours. Then as far as BTU-1 is concerned, "He's had it."

The NavCad's next step is Basic Training Unit Two at Corry Field. Here he will concentrate on instrument flying. This means he is under the hood, learning to fly and perform difficult maneuvers with reference to only his aircraft instruments. He practices long hours both in the air and on the ground in the link trainer to master navigation, using only radio aids. He must be able to make definite and well executed radio transmissions and be thoroughly familiar with radio procedures. Communications are of the utmost importance to the military pilot. Success or failure of a mission can easily result from faulty or poor radio procedure. That is why ground school at BTU-2 stresses communications in its curriculum.

Up to this point the student pilot has flown only during the day. Just before he finishes BTU-2, he is given four night flights that are purely of an introductory nature. The world below is much different at night and waiting for the wheels to touch down on the dimly lit mat has its thrilling moments. Strangely enough, this is when pilots will make some of their best landings. In five weeks NavCads complete the syllabus at BTU-2 and move on to Saufley Field for the next phase of training.

When they reach BTU-3 student pilots are well checked out in acrobatics and instruments but their flight training has been in the main fundamental. From here on they will be expected to perform a type of flying that is purely military in character. The first steps involve formation flying, commencing with three and then moving to four- and six-plane units, and at the same time learning the tactics associated with each.

Gunnery, always a revelation to the student, is also part of this unit's curriculum. There is an exhilarating spirit of adventure in diving down on an airborne target, getting it centered in the sights, having the feeling that it's been blasted to hell and then returning to the beach only to discover that accurate aerial gunnery is a lot harder than it appears! All of this makes the cadet strive harder to master the business of aiming an airplane at a target and to get more hits than his buddies.

Cross country navigation and tactical night flying round out the syllabus at BTU-3, and the NavCad moves on to the final squadron in the basic training command.

When a NavCad enters the Naval Air Training program he knows that someday he will be required to land aboard an aircraft carrier. That particular feat marks him as a Naval aviator. It may seem strange but most cadets set foot aboard a carrier at sea for the first time on the same day that they take the landing signal officer's cut and the plane settles on the deck with the hook securely in the wires. Before this event takes place, the NavCad must spend nine hours in Carrier Qualification Unit Four practicing to obey the signals of the landing signal officer. This is accomplished on a practice field where a simulated carrier deck is marked out. Learning to fly the perfect approach pattern, not too high or

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too low, not too fast or too slow but just right and with precision, requires arduous concentration. The student must also learn to have implicit faith in the LSO, a qualified Naval Aviator, whose judgment and signals are the law.

As the NavCad straps himself into the cockpit for his first real carrier landing, he probably feels a few little chills of apprehension run the length of his spine. Cold sweat may even break out on the palms of his hands as he looks down on the small carrier steaming along in the sea. The rest of it happens so fast that he can hardly remember how he did it. He recalls joining the landing pattern and then automatically responding to the LSO's signals. Once in the hands of the LSO he doesn't even remember seeing the carrier deck until he takes the cut and smacks down aboard. Six carrier landings and that's all there is to it!

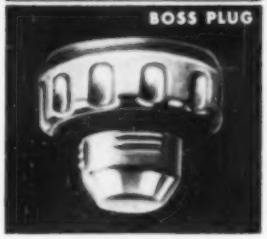
To complete his training, the NavCad must report to the Naval Air Advanced Training Command at Corpus Christi, Texas, for 17 more weeks. He may indicate whether he would rather graduate as a single engine or a multi-engine pilot, but primary consideration in designating pilots is given to fleet requirements. At present, two-thirds of all student pilots will graduate as single-engine pilots and be assigned to carrier squadrons.

The single-engine boys will spend the next 120 hours flying powerful fighter and attack aircraft as though it were a part of themselves. They will review everything they learned at Pensacola but will be required to do it all with infinite precision. They will continue to study engines, navigation and tactics. In short, the course is designed to smooth them out so that they will be able to graduate and take their place in a carrier squadron with ease.

From Corpus Christi the single engine pilots make one last move. They return to Pensacola where they must once again make qualifying landings aboard the training carrier. This time they will make 12 landings and be shot off the bow of the carrier by catapult. But there will be one big difference: they will be using the same heavier, more powerful service type aircraft, as the fleet.

The multi-engine boys complete their training at Corpus Christi. Some of them will check out in the four engine *Privateers* and others will become acquainted with the mysteries of seaplane or big boat operations in the *Mariners*. The multi-engine phase requires approximately 137 flight hours, which qualifies the NavCads as proficient co-pilot material. This completed they are designated Naval aviators and commissioned ensigns in the Naval reserve. They are then either ordered to post-graduate training in the All Weather Flight School at Corpus Christi or to active duty in multi-engine fleet squadrons.

Single-engine carrier pilots are commissioned and receive their wings at Pensacola, Fla. Some of them, like their multi-engine counterparts, will attend the All Weather Flight School or receive additional training in jets prior to their being ordered to the fleet. END



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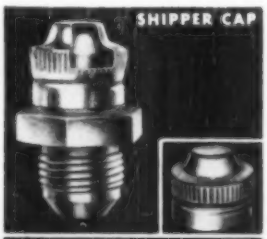

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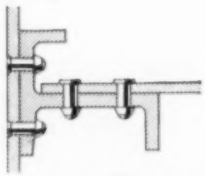

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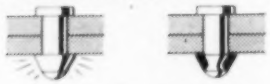

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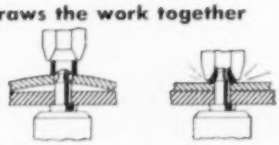

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Drones Do Work

(*Continued from page* 73)

range at high speed; to be able to operate from water, earth, ice or snow; to be able to carry three tons of cargo or people, whether well or wounded; that it be convertible to anti-submarine warfare, photographic reconnaissance, patrol, or training; that it be able to fly in all weather; to serve as an air-sea or ground rescue plane; for "general utility."

The Navy, Air Force, Grumman, the NACA, Stevens Institute, David Taylor Model Basin, United Aircraft's Hamilton-Standard Division and a crystal ball came up with the UF-1 *Albatross*.

This triphibious airplane is a high wing job with two 1425 h.p. Wright 1820's which let it cruise at 225 m.p.h. with a top of 275. Two 1,000 pound JATO bottles get it off rough water or short strips. With a range of 2,000 miles it carries a crew of pilot and co-pilot, radioman and radarman/navigator and can lug 12 litter patients or 14 ordinary people or 6,000 pounds of cargo or a gross weight of 29,500 pounds.

The *Albatross* has finally eliminated many of the headaches of seaplane operation. One—spray erosion of props—was licked when Hamilton Standard, with Navy funds, developed a nickel plate for their aluminum reversible pitch propellers. With the best water handling characteristics of any amphibious plane the UF-1 makes buoy shots and surface handling a joy. A fully-loaded UF-1, when presented with a runway short at both ends, touched down and stopped in 200 feet.

Utron's Albatross is, indeed, a far advance over the JRS of UTRON ONE which was the first military plane to take off from Pearl Harbor after the attack. Those old JRS's were unarmed and so was the Albatross which was landed in and took off from a 6 foot deep Korean river (the UF-1 draws four to four and a half feet) at night without lights to rescue a downed pilot.

The *Albatrosses* have become widely used not only in the Navy, Marine Corps and Coast Guard but also, designated SA-16, there are several hundred of them being used by the Air Force.

Utron—the most shot at outfit in the Navy—finds time between rounds with the gunners to make and interpret aerial maps, identify things, take pictures of aircraft accidents for analysis and investigations, do photostating and material design, fly plane guard for carriers, scout and observe, give aid and comfort to Arctic ice breakers, make hydrographic surveys, carry people around, and search for mines. In other words, the Navy and Marine Corps's flying Utility Squadrons do it when George doesn't show up. END

Beating the Bugs

(*Continued from page* 109)

herent to these machines.

A recent jet aircraft arrived at Patuxent with an excellent performance curve. However, when tried out on Patuxent's land-locked rotatable-carrier deck, it was found that a hard landing often-times pulled the tail-hook and a goodly portion of the tail section out of the plane. This was disconcerting on land but it would have been disastrous at sea. The plane went back to the manufacturer and returned with a "beefed-up" tail section which alleviated the problem and became a modification on all production aircraft of that model.

The Patrol section checks and analyzes the flight performance of land, sea or amphibious aircraft with equal aplomb. And their study on the "big-boats" include a study of water and taxi characteristics as well as air performance.

The Rotary section of Flight Test has most of the normal fixed wing tests to work out in addition to such specialized helicopter problems as hover performance, vertical climb and autorotation.

Suggestion on new aircraft from fleet units using them are always welcome. Operational conditions simply cannot be simulated in test work. As mentioned previously, squadrons are often flying new aircraft concurrent with Flight Test division. These operational outfits lack the scientific equipage of a test section, but they have the reactions of all pilots and while test work closely approximates operational conditions, operational flying closely approximates combat conditions—and *combat is the payoff*.

How well an airplane flies is of considerable import to a pilot, but this factor—though necessary—receives little consideration in combat. The major factor when the chips are down and the enemy is up, is how well does my plane fight?

The answer to this question falls within the purview of the Tactical Test division of NATC. It is not concerned with the weapons of a new aircraft as related to how well it fights, but only with the basic aircraft's tactical qualifications. Does it create a good gun platform and can it carry a bomb load? Can it fly higher, faster than opposition aircraft? Can it maneuver well and can it fly well in bad weather?

Normally, TT receives the number two aircraft of any new model arriving at Patuxent. Even before it is flown for tactical evaluation, work begins. The cockpit gets a going-over with the requirements of a combat pilot in mind. Is there room enough for the pilot to reach all the necessary instruments in the cockpit, not with just a nylon flight suit on, but with all the accoutrements of war. A pilot isn't quite so weighed down as the knights-of-old in armor, but they aren't clothed in bikini models either. The buffet helmet with earphones and microphone can make a tight cockpit tighter. The anti-G suit can tighten it a bit more. Add a gunsight, a navigation chart, a computer, parachute, life-raft and emergency kit. No matter how good the airplane is, the pilot has to be able to move in it to fly it to fight it.

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Pilot comfort cannot be overemphasized. Anything done to ease his physical load increases his value as an effective operator of a weapon. Pilots with size 13 hoofs and shanks to match have to have a place to put them. The seat and rudder pedals must be adjustable to also accommodate the "half-pint" who just got under the height and weight wire. The manufacturer may overlook some of these items. Tac test will help them remember, suggest a "fix."

After the ground problems have been investigated, the plane takes to the air with a TT pilot aboard. Let us assume the pilot is agreeably surprised to find this particular model flies higher and faster than anything he has yet encountered. These are excellent attributes and definitely a flight in the right direction, but it does not necessarily mean that everything is just dandy.

Although the airframe manages on its own merits without additional help at altitude, it becomes sluggish and fairly inefficient. Although the engine is more economical, it is productive of less power. The fact that the jet stream becomes more efficient is somewhat offset by the fact that the engine has to be well throttled back to keep the fuel-air ratio within reasonable bounds. It is a result of a compromise, and all compromises stop short of perfection.

So here we are at near maximum altitude. It is a twin-jet aircraft, with one jet cut off to give additional economy—it happens only in jets—the other throttled back to prevent flame-out, rumble and too much speed, ergo, buffet. Nonetheless the jet is kicking the aircraft along at near maximum allowable mach number with critical mach number just up ahead a bit. The pilot is exercising due caution because a 10° dive will ease the plane over its red-line. On the other hand a 2-G load will stall it out—the margin between stall and critical speeds is narrow indeed at top altitudes. The cockpit is pressurized and through a hose to his nose the pilot is breathing pure oxygen. The outside temperature is —67° and a heating unit inside is working at full draft to keep the pilot comfortable.

Radar ground control is required to help the pilot rendezvous with his wing man in the high, thin air of 50,000 feet. Only with the help of CIC can he vector in on his target.

So the pilot can fight his new superairplane, but it is not so simple as it might appear at ground level.

Another item that has given a continuing problem is the question of a jet's short range. T. W. Davidson, Chief Engineer of Tac test, has designed a computer which, though it can't extend the range of an aircraft, can keep the pilot apprised of how late it is. The computer gives Range, Endurance, Speed and Time for various altitudes and any quantity of remaining fuel. By dialing the wheels an enterprising pilot can know to the moment when to break off the battle and head for the roost—and still make it.

Lieut. Comdr. John Hill of the tac test VF section has designed a multiple purpose knee pad. Even though a jet cockpit

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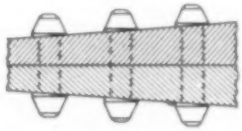

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is made fairly comfortable, it still gets cluttered up with cruise control charts, maps, plotting boards and computers. Then too, there is the problem of managing all of this gear at night. The problem is almost licked.

Although new aircraft spend the first portion of their Patuxent visit with Flight and Tactical test, the Electronics Test division get to know the new model very well. The Electronics test division of NATC averages about half of all projects under study at Patuxent. Recently, some 170 projects were underway in the big electronics hangar. About midway in World War II only 5 per cent of the total cost of aircraft was devoted to electronics. This figure had risen to 17½ per cent in 1951 and is expected to rise to some 30 per cent by fiscal 1952.

The average patrol plane has a minimum of a half-dozen transmitters which can transmit on frequencies from low to ultra high bands. A dozen receivers might be considered a bare minimum in a patrol type aircraft. The R5D *Skymaster*, a relatively elderly and dull flying vehicle in these days of jets and super speeds, has 21 receivers and transmitters in her hulk in addition to several miles of electrical wiring, an electrical switch panel large enough to keep a small boy busy for an hour.

Present standard radio equipment on most military aircraft include a 10-channel VHF. The radio and communication section of Electronics test is now working on a set having 1,000 channels. Some day if you wish to talk to your wing man, it will only be a matter of dialing his number.

The systems section of the electronics division is the outfit who decides where the switch will be on the antenna reel, the location of the various transmitters and receivers. This works out fairly well, because this outfit also gets to check the operational efficiency of the various electronics equipment after they are installed. If there is too much interference for more than a half-dozen electronics gadgets to be "on" at the same time, the systems section knows immediately who is at fault, i.e. the systems section. They also insist any faults be corrected.

Environment is everything, even in electronics. The environmental test group of electronics test can duplicate practically any bad operating condition known, and what is more, can make it even worse. Inasmuch as naval aircraft are seafaring beasts often required to operate around salt water and occasionally in humid areas such as the south pacific, the environmental group is especially good at emulating such conditions. In their laboratory they brew up salt water, salt fog, high humidity, heat and fungus. By operating the electronics gear in this variety of electronics eaters, weak links are located and corrected. In order to break up the monotony a storage battery is occasionally blown up. This comes under the heading of testing the dangers of hydrogen gas leaks in storage batteries. It can be fun in the laboratory perhaps, but very unfunny at 10,000 feet on a black night half way across an ocean. That is why the environmental section is spending time trying to correct this little problem.

The Electronics division has charge of the famous Navy *Delta* R5D aircraft. An experimental electronics flying laboratory, everything new under the sun in electronics winds up for testing in the *Delta*. The plane has the omnirange, DME and glide-slope equipment, and can fly from place to place with a minimum of supervision from the personnel aboard. One of the easiest jobs in the Navy, the job of letting electronics fly the plane is handled very well by Lt. Comdr. Sanborn, a man well-fitted for letting the airplane do *all* the work. There is more going on in the electronics division than in a kennel loaded with fleas. GCA is under continuous study; countermeasuring gear, detecting systems, antenna installation, all remain under the eye. In the various sections and laboratories, televised images can be sent from shop to shop, a stratosphere chamber can duplicate the air pressure at 70,000 feet, the temperature at 50,000 feet with humidity to match.

Yes, the Electronics Division is hard at work trying to keep pilots alive, and perhaps harder at work trying to replace them with a transmitter and a few receivers.

The Armament Division of NATC might well be considered to be the only division at Patuxent that really gets down to the business at hand. For the business of any combat aircraft is to provide a means of transportation for high-explosives on that last long mile to the enemy. The explosives come in a variety of forms, steel jacketed bullets, napalm bombs, mines, torpedoes, depth charges or different types of TNT bombs or rockets. In the final essence the only mark of real success for any combat aircraft is how well and how much armament the craft can deliver to the foe. The Armament division checks up on this question.

The Armament test pilots not only find out whether the 20 mm guns on a new type fighter fire or not, but also whether they fire in a 3 G pullout, while the plane is on its back, going straight up, under a number of other conditions. They may correct minor deficiencies, suggest other corrections, or just turn it back to the Indians, and the research outfits. But when the aircraft leaves Armament test, the fleet pilot will know from their reports whether their fighter will fire at 50,000 feet or freeze up. They will know the various ranges and altitudes of the new type rocket and rocket installations. These questions are important ones about the time the enemy heaves within the confines of a gunsight.

The last of the test division housed at Patuxent Naval Air Test Center is Service Test. The placing of service test last doesn't mean it falls in that order of importance. It is fitting perhaps, since an aircraft's assignment to service test means the end of the line so far as that particular plane is concerned. This unit specializes in taking a perfectly good aircraft and flying it until it is ready to fall apart. No malice, but plenty of forethought, is involved in this. END.

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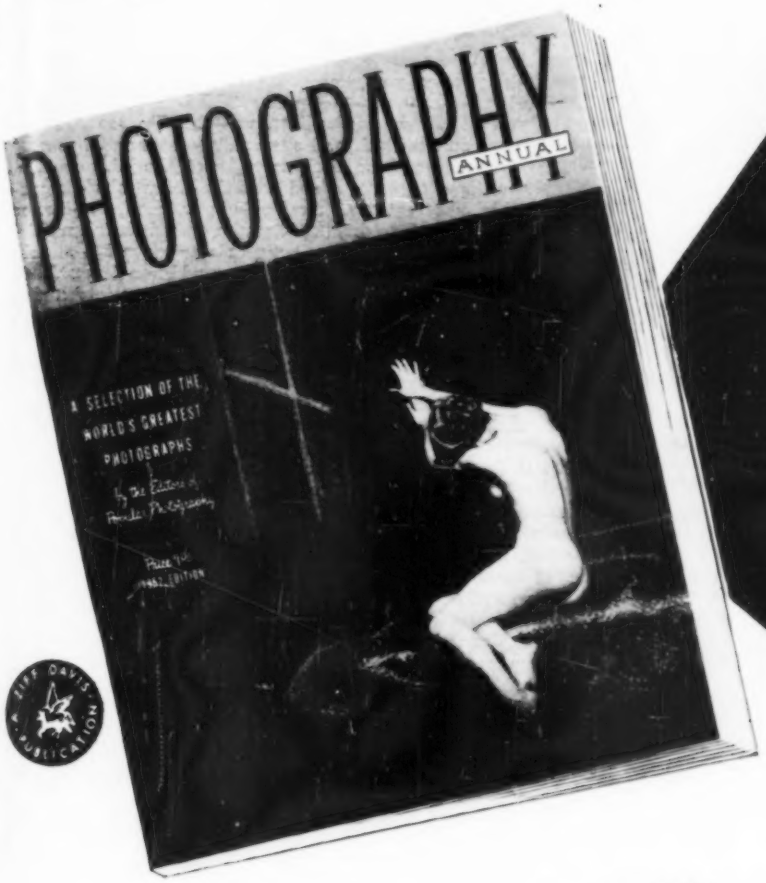

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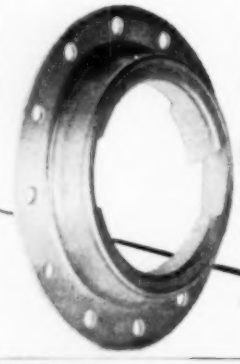

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Naval Air Power In Action

(*Continued from page* 45)

lines. Take the plane down to tree-top level and *look*; slow down if necessary; you can't see a camouflaged pillbox from 2,000 feet at 500 knots.

The rest of the war is well-known—the Chinese counter-attack, our counterattack and eventually a stalemate.

The Korean war broke this ornery beast, the jet, to saddle. Now operational both night and day, the "blow-jobs" demonstrated that, like any other airplane big or small, the carrier was an ideal base for them. Catapults erased their undesirable take-off characteristics. Being able to move the airfield 40 miles per hour into the wind was an additional asset.

Landing aboard a carrier in a jet is a snap—the jets' higher landing speeds are offset by the pilots' better visibility of the deck. New barriers—of nylon, believe it or not—were tested in combat and found to cause far less damage to an errant plane than the former steel fences. The Navy jets showed surprising ruggedness and stamina and best of all their available-for-action figures were often *better* than those of the propeller planes.

Korea did little to change naval aviation doctrine or tactics. The jet-against-jet air battle over the Yalu showed that the Grumman F9F *Panther*, for example, was slower and less maneuverable than the Mig-15. At the same time, it was more rugged, better gunned and better flown. While **one** *Panther* might be an unequal to **one** *Mig*, **two** *Panthers* against **two** *Migs* was also unequal—but in the opposite direction. Two *Panthers* were equal to four, five or more *Migs*. The teamwork tactics of World War I, involving better airmanship and gunnery, proved their superiority in the Korea skies.

The role of the Navy's patrol aircraft in the Far East has been important but unsung and unglamorous. No better illustration can be cited than Formosa. Here, naval aviation and sea power were given the acid test—to prevent Communist capture of the island, but still be available in Korea, 900 miles to the north.

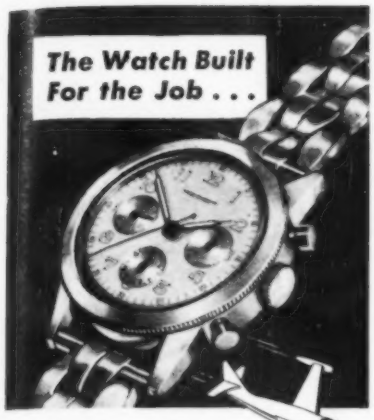
The run from Korea to Formosa was a day and a half dash for a carrier task force. With naval patrol planes constantly watching the Chinese coast, night and day, sufficient warning of any impending Chinese attack could be flashed to the Seventh Fleet in Korean waters. While no large American fleet ever patrolled the narrow 90-mile-wide Formosan straits, the Chinese Communists could look across the Straits and see their silent, ghost-grey hulls. The Seventh Fleet was out there, and they knew it, even if at the same time Seventh Fleet planes were attacking their hordes 900 miles away in North Korea.

Patrol planes played a vital role in Korea, too, as part of the blockade force. The Reds in North Korea had no real Navy, but they had multiplied thousands of small boats—sampans, junks, barges and small fishing craft, each of which was capable of leapfrogging down the coasts carrying small groups of troops or guerillas, ammunition, food or supplies. They could not be permitted to use the sea to assist their ground forces. But ships alone could not patrol the Korean coast—especially the west coast which was laced and honeycombed with islands, inlets, mudflats and afflicted with the worst tides in the Orient. Almost 4,000 islands lay off the Korean peninsula—to supervise them would be an impossible surface fleet task.

Here the patrol planes did Herculean work, day after monotonous day and with radar night after uneventful night—charting the coastal traffic, reporting any concentrations and destroying any shipping on the rare occasions it was found. The Korean coast became a real Iron Curtain hung there by the patrol planes of the Navy.

Patrol sea planes did one other noteworthy deed in Korea—mine hunting. It was found that these long-ranged, slow-flying planes could perform creditably in this department, especially in the coastal areas where receding tides exposed the pestilent sea-bombs.

The action in Korea gave naval aviation a tough test of readiness. Largely owing to the foresightedness of the late Admiral Sherman, the Far Eastern Pacific Fleet was strengthened only five months before the Korean War by the shifting of an At-



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lantic Fleet carrier—the *Philippine Sea*—to the Pacific Fleet. This permitted the assignment of one carrier to the Orient on a rotation basis. This trans-ocean shift of one of the available flattops meant that the *Valley Forge* was in Korea and in action by 3 July.

Naval aviation's readiness for the Korean War was also demonstrated by the high state of training of naval reserve aviators, and the almost immediate availability of mothballed carriers. By the time of the Inchon landing in September, six carriers were in combat—*Valley Forge, Leyte, Philippine Sea* and *Boxer*, and "Jeep" carriers *Sicily* and *Badoeng Strait*. In rapid order, mothballed carriers took their turn in Korean waters—the *Princeton, Bataan, Bonhomme Richard* . . .

To fill these ships, 13 complete reserve squadrons were ordered to active duty, and several thousand trained "week-end warriors" recalled individually. So high was their state of readiness that many were in action in less than a month. The reserve squadrons, including their ground crews, reported for duty on ten-days' notice. A faster rate could have been achieved had the Korean fighting worsened or widened. Of all the Navy's peacetime programs, none of them paid off more than the Air Reserve program.

The Korean campaign is a classic example of the overwhelming advantage of mobile air power seizing enemy territory. No better example will be recorded in military textbooks than the capture of Inchon. MacArthur himself admitted that if the United Nations forces had had to fight northward through the Reds' 14 divisions concentrated along the Pusan perimeter, it would have prolonged the war by many months and cost an additional 100,000 casualties.

The surprise landing at Inchon, 200 miles in the enemy's rear, trapped the Reds and severed their vital supply lines. In less than 30 days, their once-skillfully-led and organized army became a routed rabble, abandoning their equipment, surrendering by the thousands, and trying to escape over the footpaths and trails into North Korea. In the now-warm "cold" war period ahead, the mobility of our sea-air team is a valuable weapon.

New words—*stratactical* and *tribious*—are being coined by them to illustrate naval aviation's potential in the dark days ahead. Stratactical is a word-marriage of "strategic" and "tactical"—"We can do any task with our airplanes and carriers which we're ordered to do," they say in effect, "regardless of whether it is strategic or tactical. We're tribious." By tribious, they mean that they have all three elements of service—on the sea, in the air over the sea, and over the land as well. This triple threat was amply demonstrated in Korea by the Marines, naval air's support, and the 98 per cent of the logistics of war which the Navy has carried to Korea.

Notwithstanding their justifiable pride over their performance in Korea, it is naval aviation's firm position that more than ever, the main lesson of Korea is our country's need for an adequate but balanced military team. END

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Close Air Support

(Continued from page 58)

strafing runs to cover the areas of the woods his napalm and bombs had missed. By the time he was through, he had stopped the Red attack.

During the battle at Chosin Plateau, the air controllers were flooded by all types of U.N. aircraft, manned by pilots eager to take a slug at the swarming enemy threatening to cut off our troops. A forward air controller never had a more difficult or more important assignment. However, not all the contrc' was left to the men on the ground. The situation called for airborne tactical air controllers. Many of them were picked during a flight to handle the direction of other planes in coordinated effort with ground controllers. The controllers in the air added a slight advantage of the countryside that supplemented the controller with the infantry units.

The air support during the Marine fight down from Chosin Plateau had to be closer than ever. Ground Controller Lieut. Lawrence H. Simmon of Santa Ana, Calif., said:

"The company commander kept asking me to call the Corsairs in nearer when they attacked. The pilots were reluctant to fire any nearer to our troops, but I told them the company commander was willing to risk it. They came in so close the empty cartridges from their wing guns fell on our troops. The napalm bombs warmed our men like a bonfire—but it fried the Communists."

Following the successful Marine fighting withdrawal, Maj. Gen. Oliver P. Smith, who then commanded the 1st Marine Division, said:

"A bond of understanding between brother Marines on the ground and in the air has been established that will never be broken.

"Never in its history," he continued, "has Marine aviation given more convincing proof of its indispensable value."

In the last days of the Chosin reservoir withdrawal, the Marines added a new punch to their team—the sleek, blue F9F *Panther* jets. Time and experience in combat sharpened the jet attack.

An almost unbelievable strike was directed by an infantry forward air controller northwest of the Hwachon reservoir in central Korea who told a flight of Panther jet pilots:

"We have 50 North Korean soldiers surrendering and they are being fired on by their own people."

Earlier, about 100 Communist soldiers saved their lives by listening to a good piece of advice from a United Nations "voice plane."

Circling over a wooded ridge in central Korea, known to contain a heavy concentration of Reds, the "voice plane" with its powerful loud speakers bellowed:

"If you don't give up, the Marine gull-winged birds will get you." Also flying around the ridge were four Marine *Corsairs* waiting to dive in on the hill.

The "voice plane" then told the Communists: "One of the gull-winged birds is going to show what can happen to you."

Quickly a *Corsair* dove out of the sky and opened up with its machine guns. The guns peppered their noisy and deadly projectiles along the ridge.

The "voice plane" roared a last ultimatum to the enemy. When it was safe for the Marine flyers to make their attack, the "voice plane" gave them the signal. The *Corsairs* went in with bombs, rockets and guns blazing. This attack all but eliminated the non-surrendering enemy.

A recent dispatch from Maj. Gen. G. C. Thomas, 1st Marine Division commander, to the 1st Marine Air Wing gives a good picture of how the ground Marine, the doughfoot, feels about his flying partners. It read:

"Regimental and battalion commanders wish to express their strongest appreciation of your efforts in supplying close air support during attack phase . . ."

This is good, but there is no music sweeter to the ears of a flying Leatherneck than the common report by forward air controllers:

"The company commander reports enemy position neutralized. Thanks. We're moving in now."

This Marine Might was a result of the National Security Act of 1947. It decreed that the Marine Corps shall be organized, trained and equipped to provide fleet marine forces of combined arms, together with supporting air components we know as Marine Corps Aviation.

Later the Navy and Marine Corps directed special attention to the development of aircraft for carrier-based air support of the ground assault. Fighters and dive bombers were designed. These types were combined into the dual-purpose fighter-bomber, which could attack the enemy on the ground and meet him in the air as well.

This was done with the active collaboration of naval aviation as a whole. The skill of the Marine pilots was shared with and augmented by the pilots of the Navy. Marine pilots in turn quickly acquired ability to perform normal fleet-air functions. As a result of these efforts, the fleet marine force embarked upon its combat role in World War II as a completely integrated air-ground team.

After World War II, Marine airmen were not content to rest upon their laurels. Although diminished in size for economy, they stepped up their training and developed close air support to a fine art. And in the light of atomic weapons, they studied the potentialities of the helicopter in amphibious warfare and evolved helicopter assault tactics.

Gen. Clifton B. Cates, Commandant of the Marine Corps, states: "We are proud of the accomplishments of our aviation personnel. We are proud of their determination to remain, man for man and plane for plane, second to none in the world. We are even more proud that they do not seek glory for themselves, but rather for the whole Marine Corps as the mobile, hard-hitting, integrated team it is meant to be."

The payoff in two major wars has justified that pride. END

Airships Aboard

(*Continued from page 106*)

to remain submerged for many days at a time. Eventually they may be able to operate continuously submerged and to travel at much greater underwater speeds. These improvements and many others make the modern sub much more difficult to find and kill than its World War II counterpart.

There is no quick and easy solution to the Anti-Submarine Warfare (ASW) problem. It requires long hours of monotonous searches by many specialized types of aircraft and ships. Not only are the sharp eyes of trained look-outs required, but the use of complicated electronic search devices operated by highly skilled operators are needed as well. The blimp meets these requirements well since it is an aircraft with endurance beyond any plane and can provide space for a large amount of electronic equipment and the crew to operate it.

The many changes in airships and their employment since World War II are a source of satisfaction to blimp pilots. Most of them look back on their experience in that war with a great sense of relief that the type of operation carried on then is pretty much a thing of the past. Hunting subs has always been a tedious and difficult task at best and it will continue so, however, the gas bag boys now tackle the job with an airship better equipped for it than ever before. Also, operating as part of the hunter-killer team is much more interesting than the old solo missions.

To make airships do a better job, new flight equipment has been added. An autopilot relieves the pilot and co-pilot of much muscle work operating the controls. Controllable-pitch propellers give added control for better maneuvering.

A new fuel system, simpler than the old one, especially designed for refueling airships in flight makes refueling possible from any surface vessel carrying aviation gas. New blimps even have a multi-purpose winch which is used to take other necessary supplies aboard while in flight. No longer must the blimp return to a land base with elaborate, special airship facilities. Almost any small field is adequate for landing, and in ocean areas, reprovisioning and refueling is accomplished in flight from surface vessels or by landing on the deck of an aircraft carrier.

When the hunter-killer team goes to sea to hunt enemy subs, there can be only one successful conclusion—kill the sub.

This is easier said than done. Certain preliminary steps leading up to the kill must be successfully completed. First you have to find the sub, then after it is accurately located, it must be tracked and destroyed by using the proper specialized weapons. Each step presents special problems. No one type aircraft or ship is qualified to perform all of them. Consequently, many types are needed and used. The airship has its own special qualifications to better perform some of these preliminary steps. END

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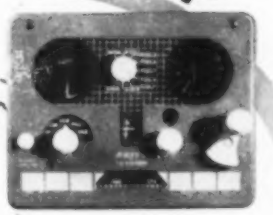

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Leighton Collins, Editor of Air Facts, has logged a comprehensive story, "5000 Miles by Omnigator," in Air Facts Magazine. He states, in summary, "A cross-country exploration and study of our elaborate omni-range and ILS facilities reveal that the system is incredibly good and that, for the first time, the small plane owner has something he can rely on in fair weather or foul, high or low, and especially in thunderstorm areas." For a complimentary copy of this Omnigator story, write NARCO.

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(*Continued from page* 130)

Station's Aero Engine Lab. If he were bribed with a cup of hot coffee, he might even say that in addition to the Aero Engine Lab, the Naval Air Experimental Station also has labs for Aero Materiels, Instruments, Structures, Aero Medical Equipment and Photographic Experimentation. By this time his boss would probably have him back at the test stand, so if more info is desired it will have to come from the boss.

He's been with NAMC's Naval Air Materiel Center for a long time and has a good insight into the overall pitch of the place. Being an extrovert by nature, he requires no coaxing to talk. From him one learns plenty of the ins and outs of NAMC.

One of the major recent projects of the Aero Materiels Lab was the development of a non-inflammable hydraulic fluid which could be used in planes without making any changes in their present systems. Many accidents and fires had been traced to the old kind that burned, but Aero Materiels, with the help of the industry, put an end to it by coming up with several cheap water-base fluids that won't burn or freeze and work just as well as the old kinds. Since the fighting in Korea, this lab has been checking and double-checking captured Commie survival gear to see if they had any new wrinkles we could use to good advantage.

The Aero Instruments Lab has its collective heads together working out ways to make helicopters easier to fly, and able to fly in all kinds of weather. 'Copter flying has required so much muscle work and attention on the part of the pilot that after a few hours of it the poor boy "ain't good for nothin'." Aero Instruments has come up with an automatic pilot for "whirly-birds" which will let our hero relax to a point short of sleep.

A "sinking speed camera," which has nothing to do with Davy Jones' Locker or that fluttery feeling in one's stomach, is the new baby of the Aero Structures Lab. Up until the time Aero Structures came up with this gadget, people whose job it is to "know" were having a rough time getting engineering data on carrier plane landing gears in service. Armed with one of these, a photographer can go aboard the carriers and record the needed data which may be used to make changes in the landing gear of planes which are now in service.

The nose and tail sections were taken from a *Beechcraft* auxiliary gas tank by the Aero Photographic Experimental Lab, rolled up together with a sheet of aluminum, and presto, the Navy and Marine Corps had a serviceable aerial film delivery shell. This eased the headaches of speeding unprocessed film from the front back to command headquarters where the film could be processed and pictures put to use immediately by the battle planners. Its operation is as simple as its construction. Pictures are made of target or fighting areas and placed in the film delivery shell. This is loaded on the bomb racks of a fighter plane, flown back and dropped down easily by parachute at headquarters. One refinement makes possible the ejection of one to four film parachute packs by static lines.

Photographic proof of ground support results is now made possible by an "ADOG" device also developed by the Aero Photographic Experimental Lab. This is an automatic attachment for standard fighter plane gun cameras which keeps the cameras focused on the target well after the plane's rocketing and strafing runs are completed. Fighter pilots won't be able to bring home the enemy skipper's pants as proof of the kill, but they sure can bring home a neat picture of them.

NAMC's Aero Medical Equipment Lab has been one of the leading factors in the development of the pilot ejection seat for high speed jet fighters. Not content with developing the seat and then forgetting about it, the Lab has trained almost a thousand Naval Aviators in the use of their own personal catapult. On a 110-foot test tower with tracks for the seat to fly up on, the indoctrinee pulls the release which sets off a smokeless powder charge under his seat. In nothing flat pilot, seat and all are hurling up the tower's tracks at 60 ft. per sec. He comes to an easy stop at the top with the knowledge of how to do it in a hurry should he have to bail out of a jet plane at speeds over 600 m. p. h. Last year the ejection seat was used eight times in the fleet. All were successful and in five cases the pilots reported that normal bail-out would have been impossible.

Very little has been said about NAAS Mustin Field at NAMC; while it isn't charged with the direct research and experimental work like the Naval Aircraft Factory and the Naval Air Experimental Station's laboratories, it is the catalyst that helps to tie all of this work into a usable package for fleet use. NAAS Mustin Field "keeps 'em flying" by servicing and test flying the assigned and reconfigured aircraft of NAMC.

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(*Continued from page* 111)

same airplane were loaded to capacity, by using boundary layer control an additional 5,000 pounds pay load could be added, which, if put into gasoline, would approximately double the range. With the additional 5,000 pound pay load, bringing the new gross weight to 26,500 pounds, the airplane would still be able to take off and land with less runway. These calculations were from two dimensional wind tunnel tests. Three dimensional wind tunnel tests may alter the conclusions, but considerable performance improvements are still expected.

If boundary layer control can improve the performance of a 20,000 pound aircraft to this extent, there is little reason to doubt that it can do likewise for other planes. Such control would enable an aircraft carrier to handle the high-speed jets much easier at greatly reduced speeds. The flattops of the fleet could be used not only as aircraft bases, but as assault-troop carriers as well.

Other research offices of the Department of Defense, as well as ONR, realize the importance of BLC, and are going ahead with various phases of the problem. The research program of the Air Branch of ONR is aimed toward more efficient flight of the aircraft of today as well as improvement of the aircraft of tomorrow.

The advent of long range guided missiles, rockets, gas turbines and supersonic aircraft has produced an unprecedented demand for new materials which can withstand severe operating temperatures and stresses. ONR's metallury research has concentrated for the past five years on groups of metals formerly unknown or considered "rare." Military needs for strong, lightweight, head and corrosion resistant structural materials have led to the development under new processes of non-scarce titanium and molybdenum, both of which will in the future become as familiar to the metallurgists in the aircraft industry as aluminum and magnesium are today.

Rapid advances in all fields of aeronautics has resulted in modern aircraft exceeding the capabilities of adjustment of humans that fly them. Speed, acceleration, altitude, temperature and other extreme environmental conditions require new provisions for shielding the pilot against them and "propping up" his functional capacities to meet them.

ONR studies on plastic models of the human head have shown that proper construction of cockpit interiors can increase the safety factor in crashes to unprecedented levels. Noise of jet engines reaches a high proportion of ultrasonic frequencies. Studies of ultrasonic vibration have led to conclusions that will prevent damage to the human ear. Other basic research is working towards a reliable anoxia warning device to warn the pilot of possible lack of oxygen. More and more fields of knowledge are being tapped to make flying higher, faster and safer—and deadly to the enemy. END

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